AFFINITIES OF PLANTS:

WITH SOME

OBSERVATIONS

UPON

PROGRESSIVE DEVELOPMENT,

BY

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"Segnius irritant animos demissa per aurem,
"Quam quæ sunt oculis subjecta fidelibus."

HORAT. DE ARTE POET.

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TO

JOHN LINDLEY, Ph. D., F.R.S., L.S., G.S.,

PROFESSOR OF BOTANY IN UNIVERSITY COLLEGE;

IN THE ROYAL INSTITUTION OF GREAT

BRITAIN; AND TO THE SOCIETY OF APOTHECARIES;

TO WHOM

THE NATURAL SYSTEM OF BOTANY IS MAINLY INDEBTED FOR ITS

INCREASING POPULARITY IN THIS COUNTRY,

THIS LITTLE WORK

IS

BY PERMISSION,

MOST RESPECTFULLY DEDICATED,

(WITH A WISH THAT IT COULD BE WORTHY OF HIS NAME,)

BY

HIS MUCH OBLIGED AND HUMBLE SERVANT,

THE AUTHOR.

PREFACE.

The present little Treatise owes its origin to some attempts which were made by me at the time I commenced the study of the Natural System of Botany, to express upon paper the connexions of some of the more intricate portions of the vegetable kingdom, and the intention was by constructing circles of affinity to be able to concentrate attention on any required group of Plants. But my work would have been rendered supererogatory by the appearance of the "Nixus Plantarum" had the general arrangement of the system been in that effected or attempted. This, therefore, was an inducement to continue to prosecute that study, now rendered far less difficult, by the assistance of so great an authority. After the completion of the arrangement of the zones, I accidentally met with that to be found in the

Cyclopædia of the Society for the Diffusion of Useful Knowledge, *art.* Exogens, which induced a more rigid examination of what I had formerly projected, and led me to venture upon breaking up some of the former groups, in order that some Affinities which could not before be expressed might be represented. It has been a subject of much satisfaction to me to find that the schemes which I have devised to express the alliances of Plants, which were principally determined by careful consideration of the individual Affinities did not involve the necessity of destroying the prior groups, which are even traceable in the arrangement I finally propose; nay, if the diagram before alluded to in the Penny Cyclopædia, which is at first sight very dissimilar, be supposed to be placed so that Diclinosæ should form the lowest group, considerable resemblance may be perceived even between these two methods. Hence it would appear that some glimpses of the truth are already distinguishable, which will at no distant period enable us to penetrate this intricate labyrinth.

No mean degree of importance can be assigned to that department of a science, which enables the student, by means of our common indigenous plants, as the St. John's Wort or Woodruff of our groves and hedges, to comprehend the structure of the Mangosteen or Cinchona; exotic productions which he never has seen, and which he probably never may behold, but which, should they chance to come before him, would be immediately recognized, and their various qualities as well understood as if they had constituted a portion of his native Flora; and it is not a little curious that this last department of Botany has been the latest to receive its due degree of attention, though by its aid alone the science has any claim to be considered philosophical, and in its objects and benefits much unlike that which it could pretend to be under different circumstances, when it conduced to scarcely any other end than the accurate definition of logical distinctions, and was apparently less the department of the naturalist than the logician; to the former of whom the chief inducement to undertake its

study seemed to consist in the hope held out of immortalizing the names of its most successful prosecutors by their conversion into barbarous Latin.

Independently of the more abstruse application of a properly constructed plan of Affinity to the elucidation of a belief of the universal connexion and gradation of beings "far as creation's ample range extends," its importance to the student of Botany consists in its making apparent to him, that orders, as the sections of Terebintaceæ, though placed in different groups are still not removed from the vicinity of each other, and the anomalies occasioned by the merging of characters into one another will be less perplexing, when the eye can perceive the manner in which this is accomplished, and the necessity that it must take place between the adjoining groups.

No absolute necessity existed for entering upon the question of Progressive Development, but it is so naturally connected with the ideas arising from the contemplation of the almost infinite

gradation of forms and structure presented to us in the plans of Affinity, that I trust its introduction, if not approved, will be excused.

It would be no vanity in me to say, that the general arrangement of the Affinities here proposed is apparently tolerably correct, as they have been placed in those positions according to the opinions of their relationship entertained by those naturalists most worthy of belief; but it would be the greatest to say that the divisions and characters proposed by one who has such a very limited knowledge of genera and species is any thing more than an excuse for a better arrangement, or that the catalogue of the orders deserves more attention than as exhibiting an artificial table, such as the student should practice the constructing of, in different ways, to gain by that means a knowledge of natural characters.

Not without some hesitation, and much misgiving, do I sign the last few words which will consign the book to the inspection and judgment of the world. My only hope is, that the little

originality to be found in it will be looked on as a single opinion among a multitude, unsettled and constantly varying; for such instances are the only ones in which I have presumed to stand alone, and then only because I was unable to obtain protection. But if, in the exposition of the faults or absurdities of this production which must take place, one single iota of truth shall be gained by the science, either by the destruction of some false principle, or the establishment of some true one, that is all that I look for—all that I desire.

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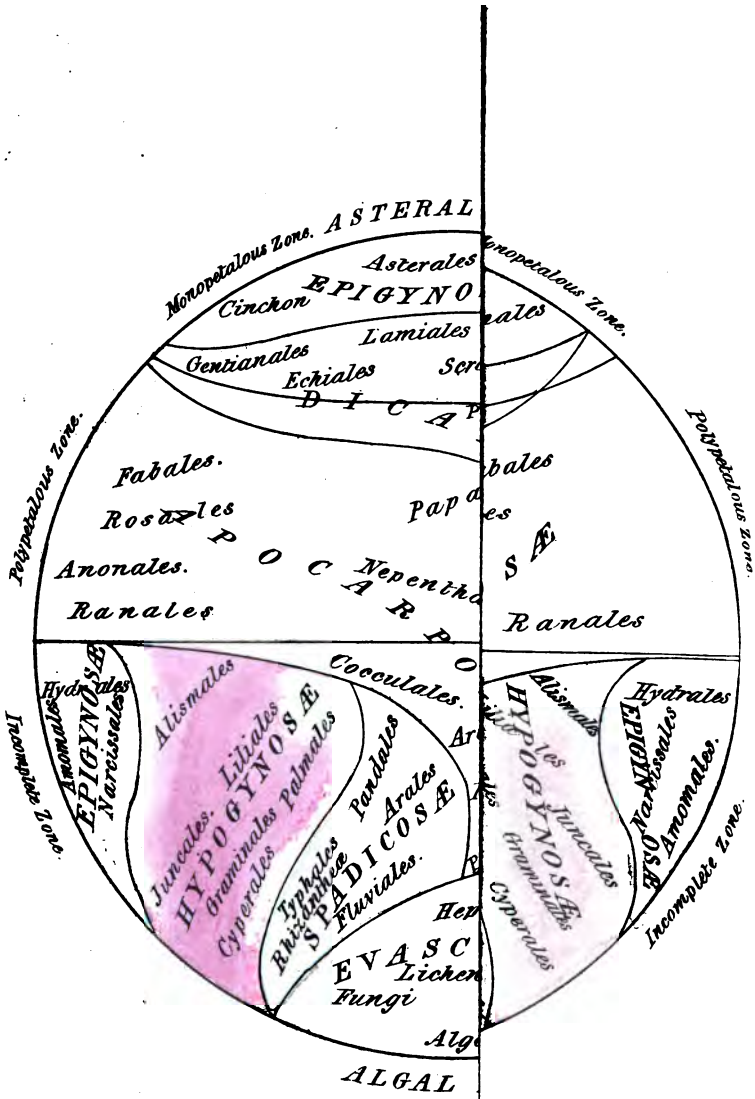

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AFFINITIES OF PLANTS.

Necessity of Synthetical Considerations.

No plainer proof of the superiority which the system of Jussieu for the classification of the vegetable kingdom possesses over that of Linnæus, need be offered than this, that the natural method presents us with a new department of botanical science, namely, the study of Affinities, or the consideration of the connexion subsisting between the different species of Plants; by which a fresh path of inquiry into the works of nature is opened, and our acquaintance with them materially enlarged and improved. On the contrary, the artificial system not only does not offer this advantage, but its tendency is to keep out of sight, or distract attention from such an object.

The system called Natural, in its ultimate purpose is intended to be such an arrangement as would suggest itself to the mind of an intelligent observer from an unprejudiced survey of the vegetable world. He would, of course, combine together such plants as bore the greatest resemblance one to another, and this being very obvious in some, he would easily group together certain

large portions of his system; such as the families of palms, grasses, compositæ, mosses, fungi, &c., a greater degree of attention would enable him to arrange many more upon the perception of points of resemblance which had before escaped his notice. Proceeding in this manner, he would effect a very tolerable system resembling that now in use; and he could not, while engaged in the task fail to perceive that certain of these resemblances were common to a multitude of plants, others to a much smaller number, and some confined to very few. These are called characters. So long as he would be content merely to take note of these characters wherever he found them, instead of applying them as means of analytical arrangement, his system would continue natural; for it would be a collection of species assembled together by the degrees of likeness borne by them one to another. But, unfortunately, it is seldom that the office of being pioneers of science is given to enlightened minds, on the contrary, ignorance and barbarism at the outset contrive a path which begins where it ought to end. The slow and gradual progress of discovery, the partial and imperfect views we can take of nature are great, if not insuperable, obstacles, to the formation of science upon the pure ground of synthetical principles. It is therefore more consonant with our opportunities and temporary convenience, to establish points of distinction rather than those of agreement, and our limited faculties require that separation by analysis which is contrary to the design of nature; hence the establishment of ordinal and generic distinctions, which, while they assist our memory, tend so much to fetter our conceptions. Yet,

lest we lose ourselves in generalizing, we are obliged to descend to particulars. It is reserved for that time alone, which shall possess a perfect acquaintance with the works of nature, or a state nearly approaching to that, to comprehend at one glance that which we must now be content to look upon from so many points of view.

Therefore, although the analytical mode is the only one which in certain conditions of our knowledge either can or ought to be put in practice, yet the formation of science in this way will be perceived by any liberal mind to be essentially defective. How well aware of this was Ray, "the father of the natural system," at a period when the science of botany was in a far less perfect state than at present, his own words most certainly manifest, "What I have elsewhere stated" says he "I here repeat and inculcate, that a system perfect on all sides, and absolute in every part, is not to be expected from me; one which might so distribute plants into genera that every species might be comprehended, none being anomalous, or the relict of its genus; and each genus so circumscribed by its own proper and characteristic marks that no species might be found of an uncertain house (so to speak) and referable to many genera. Nature allows no such thing in her economy. For she makes no leaps, nor passes from extreme to extreme, but, by something intermediate, she is wont to produce some things of a middle and doubtful condition, between the highest and lowest, which partake of both, and as it were connect both, so that it is altogether uncertain to which they belong. Besides, this same benign parent

disdains to be forced into the straits of any method; but is used to create some species in every order of things as singular and anomalous exceptions to general rules: that she may make it evident she favors no laws but her own liberty and free will." Volumes could not more thoroughly express the necessity of putting together, as well as pulling to pieces, that we may, by finding the places of these "singular and anomalous exceptions," next to those things they nearest resemble, be guided where character fails; and this is to be accomplished by the study of Affinities.

Importance of the Study of Affinities.

This very curious and to a reflective mind captivating pursuit, is a part of science peculiarly difficult; for although the most inert or inattentive person cannot prosecute the study of plants, even by the Linnean system, without being aware of the close relationship which exists among some genera and species, as in the umbelliferous, gramineous, labiate, cruciferous, or orchideous tribes, which is so palpable as even in that artificial method to have forced the adoption of some natural classes; it is the business of the student of the natural system to discover that the relationship of species is not confined to these partial instances, but is a law of the whole vegetable kingdom, although much less manifest in general than it is in such well marked cases: the reasons for which ambiguities we will endeavour to explain hereafter, suffice it to say at present they are mainly dependent upon the liability to mistake real and apparent alliance. As similarity of structure is for the

most part accompanied by similarity of properties, that alone would be an inducement to prosecute the study; but a more indispensable necessity exists for this, which is the insufficiency of characters, that is, systematic distinctions, which as we extend their application, become more and more weak in proportion as they depart from the source from which they are drawn. As the natural system is nothing more than assembling a number of individuals under the characters of those selected as types, we are apt to rely on those characters more than they deserve, but the greater our experience the less trustworthy shall we find these to be. It is the place of a plant, its relationship to the rest, which we want to discover; and not its subjection to technical rules. Instances of species with a small number of stamens in polyandrous orders, or with syncarpous fruits among a multitude of apocarpous plants, or with epigynous structure, when the hypogynous usually prevails, are scarcely worth alluding to, so common are these departures from typical character; and we are liable to meet with others much more perplexing at every turn. But general resemblance comes forward in absence of these marks, and assists us out of our difficulties, consequently the more attention is directed to that point, the more does the student acquire a real and indestructible knowledge, far above that of him who studies nature merely with a view of gratifying his desire of order and arrangement, by endeavouring to establish ordinal and generic distinctions, contrived often with much conceit and exactness, but which he who has made affinities his study knows to be useful only in those portions of the

system which he himself looks upon with annoyance. Characters strictly defined and well observed, are sure indications of our imperfect acquaintance with those departments of the system in which they are found. Character to be useful must point out to us indubitably tribes or species allied by possession of the same. It fails of this in the two opposite extremes of our knowledge. In plants like Belvisia, Dionæa, Nepenthes, or Aristolochia, there is so little of the characters of other orders remaining, or they are so contradictory and confused, that the faint traces which are left are insufficient to indicate their position. A still greater difficulty arises where well-known species and genera are claimed by many genera or orders; where character becomes perplexing, not because we cannot reconcile it to our usual standards of comparison, but because it can make surrounding families so little distinguishable. But these obstacles give the chief charm to the pursuit; it is a pleasant and profitable mental exercise to fill up by the imagination the blanks which facts have not yet supplied; or to indulge in speculative reasoning in cases of doubtful or complex affinity; or to follow the chain of connexion throughout its long course and manifold alliances: without which delightful fields for reflection science would degenerate into dry detail.

Important and indispensable, therefore, as a knowledge of the Affinities of Plants is to the advancement of botanical science, it is much more so on account of making that science bestow the means of enlarging the mind, by affording it a view of some portion of the graduated scale of being of which itself in another department

of nature forms a link. How different are the objects of the Linnean system; it is like making the stones which compose a glorious edifice the objects of our contemplation, while the sublime design and harmony of the fabric stands unregarded before us.

Uncertainty of ordinal and generic distinctions.

If any thing further should be needed to induce us to prosecute this study, it will be the growing conviction that all our divisions of nature, excepting only species, are artificial. Day after day, as our information of the vegetable world increases, we find the lines of demarcation contrived by the technicalities of science, break down in all directions. Nature, as she unveils more and more the light of knowledge, shews us genera, orders, groups, and classes, mingling together into one undistinguishable mass: if we can establish distinctions at all, their nicety must be increased and fortified by the addition of many points of difference: for the genera and orders formerly strictly limited, are found to become so gradually united by chains of newly-discovered species, that their points of union are imperceptible, and often, though these technical divisions were once supposed scarcely related, we thus find ourselves unable to define their discriminating marks with any exactness. But, whoever has been in the habit of observing the connexion of plants, has by repeated experience, found that he can expect no other result; he is more gratified than disappointed thereby, for he well knows that relative situation is all he has to depend upon, and that character, *by itself*, is fallacious and imperfect. What is the

rational suggestion arising from all this? since we find that in those parts of the vegetable kingdom we are best acquainted with this result is invariable, are we not, therefore, to conclude that were our knowledge to be extended in other directions, those orders, &c. which appear at present well bounded and distinct, would then be as much intermingled with each other as those which we now term natural portions of the system? merely because we are acquainted with a greater number of individuals in those localities than elsewhere, their connexion and alliances, therefore, become obvious. In illustration of this, we may aptly compare nature to our earth, and our ignorance to the waters which cover its surface, which, could they be entirely dried up, would disclose the whole land without a mark, except its situation and natural conformation to separate one of its present countries from the rest. The parts of the vegetable world least known to us are like the islets of the great Pacific Ocean, the tops of sub-marine mountains which here and there we can discover, while the connexion which subsists between them is hidden from our sight.

The real existence of Species.

To such a length have these ideas led some of late, that the reality of species has been called into question, upon the ground of their not being constant to their characters, as is seen in their deviations from their usual types in those forms of individuals called varieties. From this inquiry two theories have taken their rise, namely, Transmutation of Species, and Progressive Development; they are both nearly connected, the first

founded on the supposition of species so changing their nature by the agency of external circumstances as to become in different climates and ages individuals possessing distinct properties and characters from their originals; the second established on the natural inferences of the former, that all the present forms of animals or vegetables spring from a few original types; and on the geological facts that the organization of the living beings whose remains have been discovered in a fossil state in the early strata of the globe was of a simpler kind in both kingdoms than exists at present: we can soon dispose of the first, but the second demands, in one sense, more consideration. "We find" says Lamarck, the promulgator of this theory of transmutation, "that many genera amongst animals and plants are of such an extent in consequence of the number of species referred to them, that the study and determination of these last has become almost impracticable; when the species are arranged in a series, and placed near to each other with due regard to their natural affinities, they each differ in so minute a degree from those next adjoining, that they almost melt into each other, and are, in a manner, confounded together. If we see isolated species, we may presume the absence of some more closely connected species, which have not yet been discovered. Already are there genera and even entire orders, nay, whole classes, which present an approximation to the state of things here indicated. If, when species have thus been placed in a regular series, we select one, and then, making a leap over several intermediate ones, we take a second at some distance from the first, these two will

on comparison, be seen to be very dissimilar, and it is in this manner that every naturalist begins to study the objects that are at his own door; he then finds it is an easy task to establish generic and specific distinctions, and it is only when his experience is enlarged, and when he has made himself master of the intermediate links, than his difficulties and ambiguities begin. But while we are thus compelled to resort to trifling and minute characters in our attempts to separate species, we find a striking disparity between individuals which we know to have descended from a common stock, and these newly-acquired peculiarities are regularly transmitted from one generation to another, constituting what are called *races. (varieties.)*

From a great number of facts we learn that in proportion as the individuals of one of our own species change their situation, climate, and manner of living, they change also by little and little the consistence and proportion of their parts, their form, their faculties, and even their organization, in such a manner, that everything in them comes at last to participate in the mutations to which they have been exposed.

Even in the same climate a great difference of situation and exposure causes individuals to vary, but if these individuals continue to live and to be reproduced under the same difference of circumstances, distinctions are brought about in them which become in some degree essential to their existence: in a word, at the end of many successive generations those individuals which originally belonged to another species are transformed into a new and distinct species."

The same author proceeds to say, that these circumstances which produce the alteration of species are subject themselves to gradual variation. "So as each locality remains for a very long time the same, and is altered so slowly that we can only become conscious of the reality of the change by consulting geological monuments, by which we learn that the order of things which now reigns in each place has not always prevailed, and by inference anticipate that it will not always continue the same."

Although a great deal of ingenuity and a certain degree of probability is apparent in this hypothesis, yet the eye of calm judgment must perceive that it is theory unsupported by facts. Before we assent to the non-existence of species we must remember that the varieties produced by art or local circumstances, when left to themselves, either become extinct, or revert to their original types; and what is more, as Mr. Lyell, who has ably combated this theory, observes, that the presumed species show no organization or properties that do not in some degree exist in the individuals which are their prototypes; neither do they lose entirely their original distinguishing qualities, it is only the exaggeration or diminution of something which existed before, so that Lamarck's statement of new organs being assumed, and old ones lost must be treated as a gratuitous assumption. The more this property of alteration, which must also be provided for at the creation of the species, for it is not in every instance it can be brought about, the more this is developed, and the greater the distance the so-called new plant departs from its parent, the greater is the difficulty of its maintaining these qualities of cultivation

or luxuriance; or else the existence either of itself or progeny, which becomes precarious under these circumstances. With regard to the adaptation of plants to climate, that assertion is certainly founded on a defect of observation. Species by continued existence, that is to say, by a propagation in an unnatural climate, do not become inured to it, on the contrary, their power of endurance becomes weakened, they dwindle and die, and are succeeded by species better suited to the latitude or locality. The individual is not modified but destroyed, replaced, perhaps, by near allies, but not by its own varieties converted into species. These are the principal arguments advanced against the doctrine of Lamarck, which, if any one should wish to investigate further, I refer them to the second volume of Lyell's Principles of Geology, where he will find the whole question most ably debated: for I cannot allow space to enter more deeply on this subject, nor should I have noticed it at all, but that the consideration of the progressive development of the organization of animated nature, suggested by the latter portion of the quotation from Lamarck, cannot be considered foreign to our subject of the infinite gradation of species, and the construction of that form by which I shall hereafter endeavour to shew that gradation of the individuals which compose the vegetable kingdom may be represented. Not that if the mode of affinity should be really discovered its truth could be at all affected by the result of any independent theory; but if any correctness should be found in such an hypothesis, a progressing scale of relationship could be very well employed in illustration of it.

How far the theory of progressive development may be true.

If the foregoing arguments should be sufficient against the mutability of species, we can have nothing further to do with the question that arises from that theory, viz whether *species* have undergone a progressive development, but we shall find there is ample scope for discussion if we extend that question to the organization of the animal and vegetable kingdoms, as affected by the creation of new species.

Although naturalists might have been led by inference to conclude that nature has proceeded in the work of creation from the first organized germs by successive steps of improvement, it is well known that we owe the agitation of the question to the evidences of geology, which seem to shew that animated nature has advanced by a long series of steps until it has arrived at its present so supposed more perfect state. The geological facts upon which such an inference has been drawn are as follows: the first traces of vegetable life are found contemporaneously with those of animals in the lower strata, (Grauwacke,) of the class of rocks denominated transition; the plants appear to have belonged to Algæ, the very lowest of the vegetable series; the animals being, in like manner, of the radiate, articulate, and molluscous classes; but formations more ancient than these, such as the primary stratified rocks have not yet been discovered to afford any evidence of organic remains. The next remarkable step is the commencement of the vertebrate

class of animals in the form of fishes in the Ludlow limestone: but the blank which exists in the history of plants leaves us without information of their possible advance till we come upon those great magazines of vegetable remains afforded by the carboniferous strata. Here the plants chiefly consist of the higher orders of Aerogens, as Lycopodiaceæ and Ferns with extinct genera apparently related to them, but Endogenous plants of considerable development are met with, with some exogens of low grade, as Coniferæ. In the animal kingdom reptiles next appear, and continue in extraordinary development and abundance throughout the secondary formations. The existence of birds is presumed from the discovery of their footsteps in the new red sandstone; although the only remains of them yet noticed are the bones of some wader, larger than a common heron, discovered in the fresh water formation of Tilgate forest. Marsupial animals also existed, as is proved by the fossil bones of small species, in the oolite of Stonesfield. The plants of this age are Coniferæ in increasing numbers, and Cycadaceæ, which last have more fossil species here than are found living on the present surface of the earth; a genus approaching to Pandanus is also recognised during the oolitic period. It is not till we arrive at the tertiary strata, that real dicotyledonous plants are found; nor are any Mammalia known to have existed excepting Marsupialia. During the three periods into which the tertiary series has been divided, if we except the preponderance of Pachydermata among the earliest fossil Mammalia, that order with Carnivora, Rodentia, and Marsupialia, prevailed almost as at present, along

with the now existing three classes of vertebrata. The order Quadrumana has lately been discovered to have been represented in the miocene era, a jaw bone of an ape having been found in strata of this formation; but no fossil human bones have hitherto been discovered, excepting in the deposits denominated recent.

Now as to the conclusion at which we should arrive from the foregoing statement of facts, considerable diversity of opinion prevails. In the first place, the leading authorities are not agreed whether the granitic rocks which we find below the stratified formations are to be considered as the first that existed, or whether they are stratified rocks converted into the crystalline state by subterranean heat.

The supporters of the first idea believe that the ancient causes in operation upon the earth were more forcible than those we witness at the present day, and as they have gradually declined in intensity, our planet, both in its construction and inhabitants, has attained a more perfect state. Those who propose the second hypothesis, see in the operations now going on sufficient power to accomplish all that has been effected, without our being able to point out the time when we should have reason to conclude that the surface of our world exhibited a more turbulent aspect than it does at this day. Both deny the application of the theory of progressive development, as assumed by Lamarck, and the latter even doubt the facts of plants and animals having advanced by successive steps of organization.

Now, so far as this theory is attempted to be founded upon that of Transmutation of Species by natural causes,

it appears most incredible, and we have allowed the arguments to the contrary; if I may now be allowed to give my own opinion upon this matter, I would suggest, that as it appears some great authorities do not deny that creation goes on at the present time, and as in that case the miraculous interference of the Deity is supposed to be still in force upon the earth, it would not be less a miracle to suppose an almond tree, for instance, to be created from an embryo produced by a Prunus, or some allied species, and established at the will of the Creator as a distinct and permanent species, than to imagine such an embryo, or the tree in its full growth, created, we may as well say, out of nothing, since unorganized matter is scarcely less distant from a living being than non-entity. This I hope would prove a reasonable theory of progressive development, and thus we shall be enabled to show a sufficient cause why we can trace any living species by its connexions and alliances from the noblest examples of organization, till we follow it to the lowest monads of vegetable or animal existence, by those small, and frequently almost insensible gradations by which nature delights to work. The creative process would be thus made perfectly comprehensible to our rational faculties, which on the other hand must be shocked and overwhelmed by the idea that so violent an exertion of power must be made at every new step of creation as that required to originate an oak tree, or a palm, or even their embryos, unless by the operation and subserviency of those beings already in existence and nearest allied.

Progressive Development of Organization proveable from Geological Evidence.

It is very obvious that those who view the Plutonic rocks as formations from the stratified, by partial or complete fusion, must be fully aware that they are only extending the duration of the world one or more stages back, without interfering with the train of events to be performed. Let us then refer to the Geological chronicle of successive existence, and examine how far we are justified in assuming therefrom that a progressive development of vegetable and animal types has taken place.

The cautious reasoning of Mr. Lyell forbids us to draw any other conclusion, from the absence of organic remains in primary strata, than that it is very possible that the heat to which they have been exposed by their proximity to the Plutonic rocks has occasioned the obliteration of the animal and vegetable fossils, or that the impressions may have been effaced by the "percolation of acidulous waters during a long succession of ages," and regarding the paucity and low grade of such in transition formations, that these strata were produced at the bottom of a wide and deep ocean, where remains of animals or plants were very unlikely to occur, and where if any land existed, it was in the form of small islands, which would fully account for the absence of large mammalia, whose coeval existence we ought not, under such circumstances, to deny, because we cannot prove.

But others who take it for granted that organization has for ages been advancing, seem to attribute that event

to the accompanying condition of the earth, regarding this instance of progressive development only as an accommodation to a contemporaneous state of things prevailing throughout the three kingdoms of nature. They do not however consider this adaptation as the effect of chance, but as one of the greatest instances of the power, omniscience and design of the Creator.

This difference of making a theory the ground work of a science in opposition to the more philosophical mode of proceeding by induction, constitutes the distinction between the most influential writers of the day upon geological subjects. That one which impugns the continual admission of final causes will doubtless effect more good by judicious hesitation than fifty hypothetical systems can ever render to the cause of science, yet the utility of theory, provided we forbear to dogmatize, must be equally allowed. Although I fully assent so far as inanimate matter is concerned in the opinions of the inductive school, that we can discover no reasons for believing that any causes more potent or differing from those at present existing, have agitated the surface of the earth from the most remote period to which we are capable of extending our observations, and possibly we may be far, in any class of rocks, from obtaining a view of those which formed the nucleus of our planet in its nascent state, yet still the turbulent condition of the planet at some prior period is not denied. Allowing too the great influence produced by a different distribution of land and sea, the necessary consequence of that upon climate and the effect of that climate upon every existing order of living beings, yet as in the mineral world there

must have been a beginning, during which time it gradually advanced to a habitable state, so it is equally evident that when the earth began to be peopled with living things, probability is in favor of that colonization having been accomplished by the agency of progressive organization. If when organization commenced,

"A shoreless Ocean tumbled round the globe."

then Algæ or some other similar plants and the inferior classes of animals must have been the first beings that could have supported existence, but if even a division into sea and land prevailed from the commencement of the habitable state of the globe, it would be contrary to all analogy to suppose, that a highly developed Exogen would be the first tenant of the soil, and certainly impossible that a carnivorous animal could have remained long alive. If we are justified then in determining, that it is very improbable the work of creation should have proceeded from above downwards, unless we set aside all reasoning by the admission of the miracle of many orders of animals and plants having been created at once, which is as much uncalled for as to believe that the creation of the earth took place in its present state, and if we can shew the converse to be reasonable, why not allow it? If we can determine the first and last term surely we may be allowed to apply the same rules to the interval, and thus assume that a higher class of beings will not be created, and cannot maintain existence until that of those of the stage next beneath shall have been established.

The reasons upon which one school of geology founds its doctrine of final causes may in some sense be called negative, and on this account they are opposed by the

followers of inductive philosophy, let us see whether we cannot find some things of a more positive nature upon which we might argue that this progressive development of organization, as assumed by the theorists, has really taken place.

In the first place it must be thought a curious coincidence that organic remains should be found in the earth in the exact order of their dignity, and if it be urged that this arises from the fact of the present land having originally been covered by a deep ocean, and gradually converted into continents, therefore the concomitant progress of animal and vegetable life was as gradual and always advancing in the scale, still if in the revolutions of elevation and depression supposed to have gone on alternately from the thus very remote origin of the world, former continents had an existence in the strata now fused into granitic rocks, it is strange that the destruction of ancient records should have gone on to the very period from which theory would lead us to date the commencement of the organization of the two kingdoms.

There is a very strong objection to one of the conclusions which has been drawn from the discoveries of geologists, which is, "that those naturalists are guilty of no small inconsistency who endeavour to connect the phenomena of the earliest vegetation in the carboniferous era with a nascent condition of organic life, and at the same time deduce from the numerical predominance of certain types of form the greater heat of the ancient climate." We must then examine whether and to what extent this prevalence of Acrogenous forms of vegetation is due to climate, and whether they existed to

a greater degree than can be accounted for on such grounds.

Let us first entertain the question, will the greater temperature and humidity of our regions at that period completely account for the abundance and high development of Cryptogamia? It is necessary to premise that at the present day we have in all probability no climates which can stand in exact comparison with any of that remote age, because an archipelagic region with equal heat and humidity is not perhaps now to be found upon the earth, in any latitnde, for we must bear in mind the equator was most probably far hotter than at present,since our latitudes are allowed a heat equalling or greater than prevails at the tropics at this day. Consequent upon this is the conclusion that the rarified air which passed from the equator to the poles must necessarily have precipitated an unparalleled quantity of vapour in these regions.

"Ferns are now to the Phanerogamiæ in Jamaica nearly in the proportion of 1 to 10, in New Zealand as 1 to 6, in Taiti as 1 to 4, in Norfolk Island as 1 to 3, at St. Helena as 1 to 2, in Tristan d'Acunha (extra tropical) as 2 to 3. Ferns are also the most abundant plants in the islands of the Indian Archipelago. In the great coal formation there are about one hundred and twenty known species of Ferns forming almost one half of the entire flora of this formation," Now can we presume to say that in such a climate Ferns and Lycopodiaceæ might not have attained a development both in size and proportional numbers which we can have no idea of at present, for taking into consideration that the climate

might have been more damp than any with an equal degree of heat can be at present, and calling to mind the difference of the days and seasons of the tropical and temperate latitudes, it would be rash to limit the effects of such causes upon the vegetation of that period.

But we must bear in mind that heat and humidity alone do not appear to contribute sufficiently to the development of Ferns, since in the hot damp forests of equinoctial America, the proportion of these to other plants is said to be only 1 to 37, it is therefore necessary to presume that the climate, when the carboniferous strata were deposited was not only very hot and damp, but also insular.

If then, the numerical preponderance of Ferns and allied tribes be ascribed to the heat and humidity of an insular climate, that degree of heat being accounted for by a peculiar distribution of land and sea, it appears that to have had such a temperature in these latitudes there must have been large continents near the line if our lands existed in the state of islands. Why should not exogens have been developed upon these equinoctial continents even more than in our time? since it appears that the geographical distribution of these plants is in a decreasing ratio from the equator to the poles. From the enquiries of Humboldt, it is found that monocotyledons form in equatorial regions about one-sixth of the flowering plants in the temperate zone, between 36° and 52° latitude one-fourth, and towards the polar circle one third. Now if the equatorial lands, being islands, could produce the necessary degree of heat to these latitudes in the carboniferous era, would it not be a departure from

that uniformity of the system insisted upon by the inductive school for the whole earth to have consisted of small islands? If continents existed, and consequently Exogens were developed, must there not be some records of that fact preserved somewhere in the earth either discovered or undiscovered?

But if the disproportion between Ferns and Vasculares in the carboniferous period is no more as far as numbers are concerned than can be accounted for on these suppositions, still there is another argument to be advanced of the comparative importance of the two classes at that time, for we find these Acrogens not only equalling the most highly developed of the species in their class as it now exists, but exceeding them by far, while the Vasculares were of the lower tribes of their respective classes, at any rate so far as exogens are concerned, so that it not so much to the absence or presence of certain forms or grades of organization, nor their rarity nor abundance, that I would direct attention to, as to the extraordinary fact that some types, both of animals and vegetables have in past ages exhibited a variety and luxuriance of organization to be found no longer in their representatives. The fossil genus Lepidodendron connected cryptogamic plants with exogens by a link which cannot now be supplied, making Lycopodiaceæ to be altogether very different to what they at present are. Calamites, supposed to be allied to Equisetaceæ, attained a gigantic size, and there are many extinct genera and families of equal magnitude and importance which have no living representatives, nor, as far as known, existed after this particular period; but exactly as Acrogens once

prevailed in the vegetable kingdom, so at a subsequent period did reptiles in the animal. Consider for a moment the contrast between the ancient and modern reptiles, to the former of which the dominion of the sea, earth, and air, was once given, as it is now to the warm-blooded class. "There were Iguanodons of gigantic size walking on the land, Pterodactyles winging their way through the air, Monitors and Crocodiles in the rivers, and the Ichthyosaur and Plesiosaur in the ocean. It appears also that some of these ancient Saurians approximated more nearly in their organization to the type of living mammalia than do any of our existing reptiles."

The power which some plants have over others of resisting decomposition in water, in some measure diminishes the value of the proportional number of the different fossil classes, for Professor Lindley having immersed in a tank of fresh water during more than two years one hundred and seventy-seven species of plants including representatives of all those which are either constantly present in the coal measures, or universally absent, found—

1. That the leaves and bark of most dicotyledonous plants are wholly decomposed in two years, and that of those which do resist it, the greater part are Coniferæ and Cycadaceæ.

2. That Monocotyledons are more capable of resisting the action of water, particularly Palms and Scitamineous plants, but that grasses and sedges perish.

3. That Fungi, Mosses, and all the lowest forms of vegetation perish.

4. That Ferns have a great power of resisting water

if gathered in a green state, not one of those submitted to the experiment having disappeared, but that their fructification perished.

It is true that plants best resisting decomposition in water form the majority of the fossil vegetable remains hitherto discovered, still, if exogens existed as they do at this day, what reason can be offered that their remains would not be abundant, perhaps in excess, compared with those of other classes, when we consider the indestructibility of their woody parts. It seems also fair to suppose that many of their softer parts would have been found in the transition strata, since the fruits, leaves, nay, even flowers are preserved, some of them plentifully, in certain tertiary formations. Our legitimate conclusion then from these experiments, as it ought to have been without them, from the small number of species discovered in a fossil state, (which does not exceed three hundred in the transition periods) must be that many plants growing at that time have left no records of their existence. Among these may have been Exogens and Endogens, in some tribes equally as perishable as any of the Cryptogamous class, yet we must acknowledge that had these two classes existed in their present proportions, sufficient evidence of that fact might have been discoverable from their remains.

Although our present vegetation is controlled in its local and geographical distribution by some causes which favour the development of particular classes or tribes, which now and then prevail to the almost total exclusion of others, we find now in our exogenous class a power of adaptation to almost every climate and circumstance.

Is it not therefore very probable that were the earth to return to the climate of the carboniferous era, that species of exogens would appear as equally fitted to endure the heat and humidity as any cryptogamous plants? It seems like a limitation of the powers of the Creator to suppose that the highest class of vegetables must under such circumstances almost disappear from the earth, and this we are under the necessity of doing unless we allow that their non-appearance in that period was not owing to the peculiarities of climate, but that nature had not then attained to the production of superior grades of organization.

But it is stated that there are many instances of what may be called "retrograde development." Dr. Buckland observes "The Sauroid Fishes occupy a higher place in the scale of organization than the ordinary forms of bony fishes, yet we find examples of Sauroids of the greatest magnitude and in abundant numbers in the carboniferous and secondary formations, whilst they almost disappear and are replaced by less perfect forms in the tertiary strata, and present only two genera among existing Fishes." Now this fact will bear looking upon in a totally different light, when fishes formed the highest class of animals, we ought not to be astonished "that they united in a single species points of organization which at a later period are found distinct in separate families." Such seems to have been the case in every instance we find of the successive predominance of the classes of animals and vegetables, and nothing appears so conclusively to demonstrate that they followed in their appearance the order of their rank. When reptiles in the secondary

periods constituted the chief tenants of the globe, their organization was more complex and they approached nearer mammalia than they do at present, and when during those ages mammalia first began to be developed, the marsupial family which unites in itself points of resemblance to almost all the other orders was the first that appeared; so that it looks as though the grand scheme of creation proceeded by rapid sketches of the different classes, the detail of the design being left to be filled up in after ages. Exactly similar instances are observable among plants; at the period when Ferns and Lycopodiaceæ prevailed, they approached the higher classes by forms and links now totally lost. They then formed a predominant, now they are a subordinate, feature, in vegetable nature.

The order of Palms which is among the most highly organized, but at the same time almost an epitome of endogenous vegetation, seems in like manner to have been early established.

Another argument made use of against the idea of a progression of development is as follows: "In the ancient strata of the carboniferous era between two hundred and three hundred species of plants have been found. In these, (say the authors of the Fossil Flora,) no traces have as yet been discovered of the simplest forms of flowerless vegetation, such as Fungi, Lichens, Hepaticæ, or Mosses, while on the contrary there appears in their room, Ferns, Lycopodiaceæ, and supposed Equisetaceæ, the most perfectly organized Cryptogamic plants." But this cannot be considered to militate against the theory, because in the first place we are not supposed to discover

in the carboniferous strata the first vegetable tenants of the earth; vegetation might have commenced by Algæ and advanced to Ferns and Lycopodiaceæ by a train of species holding the place of Mosses, &c. which had then become extinct, while Mosses or Hepaticæ themselves might not have been created; but in the second place if they were, the experiment upon the durability of plants immersed in water might sufficiently account for their disappearance, and thirdly, the conditions of the climate are supposed to be such that if the same argument is to hold good in all cases, we could not expect these plants to have appeared. But the same authors, after thus urging the prevalence of the highest forms of Cryptogamic plants, declare that the most highly developed monocotyledons also existed, "as Palms and plants analogous to Dracænas, Bananas, and the Arrow Root tribe. And regarding the dicotyledons of the same period, Coniferous trees were abundant while the fossil Stigmariæ which accompany them belonged probably to the most perfectly organized plants of that class being allied to the Cacteæ or Euphorbiaceæ." Now it admits of strong doubt whether the Stigmariæ which are here said to be allied to Cacteæ or Euphorbiaceæ can be considered so in any other point than that of habit, as the mere mention of two orders so widely distant yet considered alike in affinity to these plants, cannot fail to show. In the absence of the proofs which the discovery of the flowers of these curious plants would afford, it is as fair to suppose them connected with Podostemaceæ or some such low grade of Exogens as with Cactaceæ or the Euphorbiaceous tribe, to which orders the aquatic habit alone is diametrically

opposite. "But supposing, continue the same authors, that it could be demonstrated that neither Coniferæ nor any other dicotyledonous plants existed in the first age of land plants, still the theory of Progressive Development would be untenable because it would tend to shew that monocotyledons are inferior in dignity, to use a more intelligible expression, are less perfectly formed than dicotyledons: so far is this from being the case that if the exact equality of the two classes were not admitted, it would be a question whether monocotyledons are not the more highly organized of the two, whether Palms are not of greater dignity than Oaks, and Cerealia than Nettles." Now though Exogens and Endogens may be said to take their origin on an equal level from Cellulares, and though they keep pace with each other for some time in development, yet do not Exogens decidedly overtop the parallel class at last? If Palms and Oaks, or Grasses and Nettles are considered on an equality, surely the same is not the case when a polypetalous or monopetalous plant is compared with any monocotyledon. If this be true, we draw a different conclusion as regards the equality of these classes, and we can use it as an argument in favour of Progressive Development, if the petaloid dicotyledons cannot be proved to exist at the same time and with equal development as Cellulares, Endogens, and the lower tribes of their own class.

The existence of Endogens at this period might indicate merely that the Acrogenous class had passed their climacteric, and while they were on the decline, creation was becoming more varied by the introduction of these new types of organization. We are irresistibly led to

the same conclusion if we allow the doctrine of a progressive creation, on account of the existence of Coniferæ and some presumed dicotyledons. But monocotyledons appear to be very considerably advanced in this era, while Acrogenous vegetation was at a very high, if not at its highest point of development: can we account for this at all by supposing for a moment the effect of an introduction at the present time of a new class? In the course of some ages we might expect records of this fact to be preserved in the stratification of vegetable deposits, where the fossil species of the older class would no doubt form the majority, the trunks of Exogens prevailing in all probability, and forming as prominent a feature in the strata of our time as Ferns do in the carboniferous deposits, while the number and variety of the fossils of the new class might resemble that of Endogens in those periods. But in course of time the species of the new class might in a great measure operate to the exclusion of those of the older ones, and they might hereafter preponderate as much over the rest of vegetables as Exogens at present do. And something of this kind we must, if we can at all allow a gradual process of creation, suppose to have really taken place, for the introduction of Endogens must have had a great influence on Acrogens and that of Exogens on both.

But perhaps we shall be more inclined to allow a doctrine of progressive organization when we consider that a constant advance is not required; that it is sufficient if a continual increase of importance in some way or other be obtained. The full height which a class might ever attain could be as it were built up by no great

number of original species, or types, and these might afterwards increase the class as it were in lateral extent: but it certainly is required that the succession of the classes should be in exact ratio to the amount of dignity which each is intended to obtain.

Returning to the so supposed continually advancing movement which is thought to be manifested by the geological evidence before mentioned, it is said again in opposition to such an inference that development has by this criterion sometimes remained stationary, the mammalia of the tertiary periods are given as instances of this: the animals of the eocene era are asserted to be of a rank as exalted as those of the miocene; and those of the miocene to be similarly circumstanced with regard to the fauna of the succeeding epochs, but it may be very well allowed that considering how much of the knowledge we possess on this subject has been gained within the last few years, that we have too little acquaintance with the fossil remains of these periods to be able to deduce any very conclusive evidence: yet among the facts which have come to light one in particular is worthy of notice, namely, the great development of Pachydermata in the earliest tertiary ages, and the evident connexion of the species then existing with Cetacea, and again, the increasing importance of the families of Ruminantia, Rodentia, and Carnivora, as we advance towards the later periods.

The first traces of quadrumanous animals hitherto discovered belong to the miocene or second of the tertiary epochs; mention of this brings us to consider the question, how far the introduction of man can be con-

sidered as supporting a theory of progressive organization. It is contended that this event is by no means confirmatory of such a doctrine, for, in the first place, the organization of man, abstractedly considered, gives him no decisive pre-eminence, and secondly, regarding his moral faculties that such an endowment is so unparalleled an event that it ought rather to be considered as an exception to all established rules. In respect to the quadrumanous races, the link by which man is connected to the rest of animals, their organization may perhaps on the whole be looked upon as not more perfect than the rest of their class, for it is no uncommon thing to find the inferior species of high tribes equalled or excelled by the superior grades of lower orders; there is, however, among animals one tangible point which can be seized on as absolute proof of the respective ranks of classes and orders, I mean the development of the embryo, which it is known passes successively through the several grades below that of the station to which itself belongs. Thus the earliest perceptible germ of the future human being differs in no respect in structure from the simplest Zoophyte, all that it can be demonstrated to consist of is a membranous bag containing fluid, subsequently the embryo resembles the invertebrated animals in the want of concentration of the great centres of the nervous system, for the spinal chord is at first no more than a chain of knots or ganglia; afterwards, before the extremities are produced from the trunk, the simple condition of the chord resembles that of the lowest fishes, and as in most of this class the optic lobes are larger than the brain; the extension of the cerebral hemispheres over

these and the cerebellum, takes place in exact proportion as the various classes and orders obtain a rise in the scale. The osseous fishes are without ventricles in the brain, which are only attained in their class by the rays and sharks, and the human embryo in this respect resembles the first of these at one time, as it does also in the median lobe of the cerebellum, the only one existing in those animals, being the first developed. In the early state of fœtal life, the different ventricles are seen to form compartments of one general cavity in the cerebral mass, instead of being as they eventually are, almost completely separated from each other. The depth and number of the cerebral convolutions are also in an increasing ratio, according to the amount of dignity attained; but although there is abundant proof, that the brain of the human fœtus passes successively through all the states of the same organs in inferior animals, we will not enlarge too much on that point, since it may, on account of being the intellectual organ be considered not exactly fair ground: this objection however will not apply to the spinal chord, the length of which seems inversely as the rank of the animal. At one period of the existence of the embryo, this extends through the coccygeal vertebra as in apodal fishes and tadpoles, and Cetacea, in which among mammalia it is longest, while it is shortest in tail-less Cheiroptera, Quadrumana, and man, in whom after a gradual contraction in the spinal canal it finally terminates at the first or second lumbar vertebra; but the nervous system is not the only one which offers these curious transformations, the heart of the fœtus is at first single as in fishes and frogs, and afterwards partially double

as is that of the higher tribes of reptiles; while it can be proved to have been formed from the aorta, which existed at one period like the pulsating dorsal vessel of insects. In his respiratory organs he had at one time gills like a fish, birds which he resembled at one time in the formation of his brain he does also in his employment of a yolk bag, there is also during his progress to perfection an allantois as in Ruminantia, which he also resembles in the enormous length and convoluted state of his intestinal canal; as in Rodentia the uterus was once bifid, the epididymis distinct from the testes, the tunica vaginalis not distinct from the cavity of the peritoneum; at one time too the kidneys were lobulated. The skeleton offers also in the formation of the hand a gradual state of improvement, from the fin of a whale, the single phalanx of the horse, the more improved paw of carnivorous animals, the wing of the bat, the hand of the ape, to that beautiful instrument of mechanism to which perhaps man is indebted for his preeminence almost as much as to his mental powers. The highly developed clavicle of man is only rudimentary in Carnivora, and altogether deficient in Pachydermata and Ruminantia. The intermaxillary bone, which is exceedingly developed in Cetacea, and permanently separate in most animals, and temporarily so in the human fœtus, becomes united in the higher quadrumana and man: nor is the erect posture slowly attained through the gradual approach to the highest of animals to be neglected as an indubitable indication of superior rank, and as applicable to the improved state of our knowledge as when the Roman poet made the "os hominis sublime" the chief physical distinction between our

species and the rest of animals. Thus does man, regarded in the light of his physical superiority alone, appear like the finishing stroke to the magnificent design of creation; his mental powers must certainly be allowed to be without parallel in the scheme of things amidst which we exist, at the same time this seems to indicate that the future perfection of our planet is to be principally sought in the agency of this moral being.

And thus does it appear that the facts which have hitherto come to our knowledge of the past and present history of the organized beings of the earth contain nothing absolutely contradictory, but on the whole tending somewhat to confirm the opinion, that we can discover in the successive geological epochs, a gradual and progressive development of organization.

Recapitulation.—Let us now, as briefly as we can, recapitulate the points which seem favorable to the establishment of this theory:—

1. It appears that at different times different families of animals and plants have been predominant in their respective kingdoms in numbers and development, and that the succession of them on the earth has been in the order of their dignity; and it is not improbable that although there is now many a break in the chain of affinities, that a complete scale of gradation may have existed, by which the works of creation have advanced, possibly by the endowment of the embryo with a peculiar power of taking on an improved state, accommodated however to the then existing conditions of the earth.

2. We find in the vegetable kingdom an instance of this predominance of a particular class in the fact of

Acrogens having the ascendancy in the carboniferous periods.

3. Although Endogens appear to have existed contemporaneously, it is questionable whether they were in sufficient numbers or development during the height of the Acrogenous era: for the fact of co-existence cannot be considered decisive evidence against progressive development, unless the highest grades of two different classes can be proved to have existed at the same time with equal conditions: and perhaps not even then, for the priority of the creation of the one is not affected by the fact of another class being contemporaneous at some period of their mutual existence.

4. If Exogens, that is to say those properly so called, existed in the carboniferous era, they are of the lowest organization: if we allow the humidity, heat, and insular formation of the land in our latitudes to have been especially favorable to the production of cryptogamia, in fact the sole cause of their predominance at that period, why should not the equatorial regions which it appears should have been continental, have produced Exogens in arborescent forms? for their continental formation would not have been very favorable to the growth of Ferns, &c. and Exogens appear from the present data to increase in numbers as they approach the line, at all events it is certain they do so in development.

5. Exogens ought then to have been more abundantly produced in equinoctial regions in transition periods, and their forms and organization more varied and developed than at the present era, for we presume the existence there of a climate very favorable; and if the high organi-

zation of the Acrogens of that day be ascribed solely to the influence of climate, that rule must certainly hold good with respect to the other divisions of vegetables: would it not then be most probable that had exogenous plants existed, their remains would have been preserved, perhaps much nearer the poles than where they grew; having been drifted by rivers or oceanic currents?

6. It seems difficult to assign any reason if we allow the existence of the three classes of vegetation, that none but the members of the Acrogenous class should have been created capable of enduring the peculiarities of the existing climate of the earth.

7. Providing that Acrogens and Exogens existed together in their fullest development, would not that be a departure from the established laws of compensation, which do not seem to allow a predominance in one part of the system, unless a corresponding diminution be made in some other quarter?

8. The instances afforded of this successive predominance of beings gradually rising in the scale, are more numerous and confirmatory of the theory in the animal world than in the vegetable, owing perhaps to the imperfect history we possess of plants: and the evidence afforded by the animal fossils seems positive, because had the mammoth, mastodon, or any of those enormous Pachydermata, been in existence at the same period as the Iguanodon or Megalosaurus, why should we not have discovered their remains as well as those of these land reptiles?

9. Upon the principle of compensation, progressive

organization instead of being a departure from the uniformity of the system, is in perfect acoordance with it; since no one will pretend to say that the earth itself can have been always in a similar state, although the same causes may for ever have been acting upon it with unvarying intensity, they have probably done so in different regions at different periods of time; in the same way we may consider the force of development to be exerted now upon one, now upon another division of the animal or vegetable kingdom.

10. Such an exertion of development is not necessarily progressive, yet we may infer that it has been, since the foregoing facts, as well as theory, would lead us to believe that the formation of the earth and its adaptation to living beings must have been gradual: we know that on a bare rock or a world of waters, the lowest tribes of both kingdoms would be the first if not the only colonists, and if neglecting the successive instances of improvement which we find in the evidences of the past existence of organized beings, we look to the other extreme, we find that by the creation of man the highest class of animals has received an unquestionable rise of dignity; yet in accordance with the principle of compensation that predominance has not been effected without occasioning a corresponding diminution. In the short period during which man has inhabited the earth he has extirpated some species, and as his dominion becomes more extended many of the noblest of animals will in all probability utterly disappear from the globe.

11. There may nevertheless be a kind of lateral development, which may account for the number of inferior

tribes still existing, or the monads of animal and vegetable life may be continually contributing to the beauty and variety of creation by giving birth to the first links of new chains of beings, extended at intervals in a direction from one extreme of animated nature to the opposite.

Rank of Plants.

Before we endeavour to establish any plan of Affinity, it will be necessary to make a few observations upon a subject bearing closely upon that, namely, the respective rank or dignity of plants, and the means we possess of ascertaining the same. That this is no easy matter will appear when we reflect that imperfection is impossible in any work of supreme intelligence: our ideas of one plant having a station above that of another will not be drawn from any positive defect observable in the lowest, but from some excellency we fancy to discover in the higher being. A moss or lichen is as perfectly fitted to the conditions it is intended to fulfil, and its organs as completely adapted to that purpose as the stately Palm, or magnificent forest tree. To imagine one plant therefore more noble than another, we merely imply that we consider its organization, either by its complexity or some other character, to raise the plant possessing such qualifications above the surrounding species. When our investigations on this subject are confined to plants upon or nearly upon the same level, the problem is so intricate that it scarcely admits of solution; but when we take species separated by a long interval, the sum of additional properties enables us to decide with more certainty; yet

the amount of difference is so trifling, and probably so exquisitely compensated for, that the balance is by no means so great as might be expected. In consequence of this, it does not appear that any one has as yet been able to suggest what ought properly to be considered as the highest kind of plant, and the same difficulty would occur with regard to the lowest, were it not decided by the degree of proximity to the animal kingdom.

It will be seen therefore that this kind of study is essentially comparative, and our proper attainment of it dependent upon the extent of our acquaintance with the vegetable species, and their organization, and on a proper interpretation of the importance of the characters which we construct from these, which as character scarcely ever maintains an equal value in all its relations, lays open another source of difficulty.

The vegetable kingdom easily separates by its anatomical structure into two great divisions, the Cellular and the Vascular, and there being in the latter an addition of obvious parts as well as a more complex internal structure, we hence deduce the presumption that we may place the Phanerogamous or flowering plants above the Cryptogamous or flowerless tribes. But the vascular class is again susceptible of division, yet as this consists more in the arrangement of their organs than the addition of any new ones, it is in some measure a matter of opinion which is to be considered as highest in the scale, or whether they are not upon a strict equality as is advocated in page (29.) But upon examining the peculiarities of each class, I cannot resist the conviction that a case may be made out in favour of the preeminence of Exogens,

and the same thing seems to be demonstrated by Affinity, as will be shewn hereafter. Both Endogens and Exogens have an undoubted origin or fundamental connexion with the cryptogamous tribes, as is apparent in the approximation of Rhizanths to Fungi, and Pistiaceæ to Hepaticæ in one class, and of Gymnosperms with Ferns and Lycopodiaceæ, Casuarina and Equisetaceæ, and probably Podostemaceæ and Jungermannieæ, in the other. Hence we must conclude they spring as it were from the same base or level, and being thus parallel classes the eventual supremacy of either must be determined from the extent of their progress upwards. Now we can readily admit that a Palm or a Lily possesses superior rank to such dicotyledonous plants as Callitriche Piper or the majority of Urticeæ; or that they are at least equal to an Elm or an Oak; but perhaps there is quite as good evidence to prove them inferior to a Rose, a Camellia, or even a Ranunculus, for if we compare these fully developed Exogens with any Monocotyledons, none can I think, hesitate on which to bestow the superiority. The trimerous flowers of the Lily, Amaryllis, or Orchis, however highly developed,or delicate in texture their parts may be, have nothing to set against the capacity for variety of organization which the quinary formation of the flowers of Rutaceæ, Guttiferæ, or Leguminosæ, in common with other dicotyledons, enables them to assume. What character have the former to counterbalance the excessively compound leaves of some Exogens; or what to compensate for the want of a trunk, or that genuine state of it found in the dicotyledonous class, and which does not belong to any plant within their

ranks? We suppose then, that a polypetalous Exogen is superior to the whole of Endogens, and as we have allowed this latter to be of equal rank with imperfect dicotyledons, these last must likewise be inferior. Are Polypetalæ then the highest in the scale of vegetation? I believe not; I should place monopetalous plants above them for the following reasons:—

1. In the first place they contain among them very few species which are ever destitute of petals.

2. Their affinities lie with the highest of the Polypetalous orders, very dubiously, if at all, with imperfect Exogens, and not at all, that I am aware of, with Endogens.

3. The symmetry of their parts is very seldom departed from, they have five sepals, five petals, five stamens, seldom more or less of either, except upon the extreme borders of the group.

4. Lastly, if the principle of concentration, or the condensation of each organ be allowed as influential in bestowing rank on plants as it is on animals, these have the calyx for the most part tubular, or its divisions in some degree united, the petals always so, the fruit nearly always syncarpous, and the separation of the sexes very rare. Carrying out this principle to its full extent, I place Compositæ at the very highest point of all, because in addition to these other characters, they have their stamens syngenesious, and their inflorescence crowded in such a manner as to present the appearance of its concentrated blossom forming only one flower.

Let us now consider what principles as conferring superiority, we have relied on in the preceding summary of the rank of plants. The first and most important of them is—

1. *Complexity.*—That is, the addition of organs whether in the ultimate tissues, or the arrangement of these tissues into new organs, and the multiplication of these organs. This principle may be considered under the following heads:—

(*a*) Addition of anatomical structures, as the spiral vessels, ducts, fibre, stomates, &c. of Vasculares, compared with Cellulares in which these organs are absent or imperfectly formed.

(*b*) Addition of obvious structures, as the stem and leaves of the higher Cryptogamia, compared with the want of these in the lower tribes, or of the floral envelopes and sexual organs of Vasculares compared with the before-named class, or of the wood, pith, and bark, of dicotyledons, contrasted with monocotyledons, or the quinary number of parts, the two cotyledons, and numerous buds of the former class, with the ternary number, single seed lobe, and solitary bud of the latter.

(*c.*) Articulation—which is an evidence of the perfectly formed state of organs, as the petiolate disarticulating leaves of Exogens, a character almost entirely deficient in Endogens, and the pinnate leaves of some of the former in respect to others in the same class, and decompound and supra-decompound leaves with respect to pinnate. It is indeed probable that any kind of articulation confers some degree of rank, as that of the branches, flowers, or anthers of some plants, or even perhaps the connexion of the anthers and filaments as seen in the adnate, innate, and versatile forms. This last property will require more care in its application than the two former ones, and we must remember that articulation

unless it takes place between two different organs, is absolutely detrimental to rank, as it is in the lower classes of animals and plants, (Algæ Articulatæ) being opposed in those instances to the next principle, or

2. *Concentration*—Which is manifested in the collecting of structures into organs, and again, by the assembling together of these organs, and thirdly, by the union of the parts of them by adhesion.

(*a*) The first mode in which the principle appears is in such instances as the formation of special organs, such as the elimation (so to speak) of the wood, pith, and bark, of Exogens out of the state of confusion in which these tissues exist in Endogens; or the formation of a flower by the assemblage of the stamens, and pistils, and of the floral leaves to these, forming first a calyx, and subsequently a corolla; or in the formation of a continuous stem out of the joints of the articulated Algæ.

(*b*) By the collecting these organs together when fully formed, as the leaves from alternate to becoming opposite, or the flowers from being scattered up and down, as it were, in the axillary forms of inflorescence, to the concentrated forms of the panicle, umbel, spike, or head.

(*c*) Adhesion appears to be a form of this principle, the consolidation of sepals, and petals in particular into a monophyllous calyx, or corolla, whatever purpose that union is intended to fulfil, seems a most important criterion of rank. The adhesion of the carpels has probably the same signification, so have in a smaller degree, and more confined range of comparison, the monadelphous and gynandrous structures; but one of the most remarkable and important cases of adhesion is to be

found in the cohesion of the calyx and ovary, producing what is called the inferior ovary and superior or epigynous calyx. The relative value of these modes of adhesion appears to be thus, first, the adhesion of the petals, then the epigynous structure, then the adhesion of the sepals, next the gynandrous flower, and lastly the monadelphous form of the stamens. This quality differs somewhat from concentration in these particulars, concentration collects the parts of a plant from a spiral into a verticillate form, their further union is due to adhesion: on these principles valvate estivation of either floral envelope must be taken as conferring a certain degree of dignity, for it shews that the parts have assumed the state of a perfect whorl prepared to form by adhesion a more or less tubular calyx or corolla. It will be requisite to bear in mind that the concentration of organs is very different from confusion of the same; it is one thing for organs never to have been separated, as the stem and leaves in Marchantiaceæ, or Pistiaceæ, and another for them to be confounded subsequently to their formation, as the pistils and stamens of Asclepias, or Orchis.

3. *Symmetry*—which no one doubts to be a principle conferring dignity, so far as regards the distinction between centripetal and centrifugal Acrogens, may very probably be carried to its full extent, and a species with its flowers regularly formed, *cæteris paribus*, assumed to be of higher rank, than one which is irregular in any of its parts.

4. *Development*—as comparative size, and beauty, must be allowed in some measure to confer rank.

5. *Numerical Preponderance* of species, or genera, in

genera, or orders, may be expected to bestow some importance, because we may naturally look for greater variety of organization where there is extensive scope, than where the limits are more contracted. Thus, as an additional reason for the exaltation of Compositæ, it is worthy of mention that the catalogued genera in Dr. Lindley's last edition of his Natural System, amount to 840 in this order, while those of the whole vegetable kingdom are put down as 7840. This single assemblage of plants contains then about one-ninth of the generic divisions of all the known plants of the earth.

In the application of any of these principles we must not regard them as absolute, excepting perhaps the first so far as regards anatomical structure, that being a physiological distinction more important than all the rest: we must balance these principles one against another, and allow them value depending upon their proper signification with the plants in which they are found. We shall then discover that there is in every section of the vegetable system as compared with another, a strong tendency to general equality, by the exaggeration of some properties on one hand and the diminution on the other; thus if the adhesion of the parts of the calyx and of the corolla in synpetalous plants is allowed to give pre-eminence to that class, this is in some measure counterbalanced by very few of the species attaining an arborescent form, which is not uncommon in Polypetalæ, and almost universal in Incompletæ. If Monopetalæ are high by possessing the perfectly verticillate united petals and sepals, Polypetalæ have something to set against that in the number of their stamens and carpels, although

this is perhaps a departure from symmetry, again compensated for by the superior size of their petals; and all these plants with their finely formed showy flowers must yield in grandeur to such Incompletæ, as the Banyan, or perhaps some Pines. We have also seen how nicely Endogens can almost balance Exogens in organization, and as a general rule they undoubtedly excel them in external appearance, and this has perhaps occasioned some prejudice in their favour. What other handiwork of Flora can exceed the delicate beauty of liliaceous, or amaryllideous plants, the princely magnificence of the Palm, the vivid colours of Iridæ, or those wonderful and splendid parasitical Orchideæ, which in the tropical forests render the dead and fallen tree an object more beautiful than when it flourished in its prime. So that real and apparent excellence seem almost to be bestowed in an inverse ratio.

The characters drawn from the development of the embryo do not appear to have been made, nor are they perhaps susceptible of being, a means of determining the rank of plants as they are with regard to animals. Those qualities of the seed which are considered to bear upon this point shall receive due attention in the subsequent observations on Affinity; and till this question, most worthy of being agitated, shall have received the examination which it is hoped will well repay the task of investigation, we must remain content with the small balance obtained from the compensation of qualities for ascertaining the respective ranks of the species of the vegetable kingdom.

Affinity and Analogy.

We have now arrived at that point of our investigations, which is more intricate and exposed to ambiguities than any thing we have yet contemplated, and which indeed forms the chief obstacle to our proper understanding of the relations and connexions of the system of plants. It is often a matter not admitting of decision whether a plant is really allied to another, or only apparently so, because the characters by which we judge of affinity are so general that they are possessed in common by many plants; and what is more, it has been thought that characters in one plant very similar to those of another are not always be taken as signs of alliance, but only of analogy; for instance, if we meet with a plant which is hypogynous in its structure yet otherwise scarcely distinguishable from an epigynous one, we must hesitate to pronounce them related until we find evidence of that by discovery of species in which these opposite characters are intermixed, as they are in the transition from Rosaceæ to Myrtaceæ. Of course the correctness of its position depends entirely on the value or degree of trust to be reposed in these characteristics. The same thing holds good in the classes, as well as the groups or orders of them, and the palpable resemblances of Alismaceæ and Ranunculaceæ, Smilaceæ and Menispermaceæ, Araceæ and Piperaceæ, have sometimes been passed carelessly over, because one was an Endogen, and the other dicotyledonous. Dr. Lindley defines analogy as remote affinity, and affinity as close analogy; hence any plant which has considerable

analogy with another must certainly be related, and the plants before given as instances, although in different classes, must in all probability have their points of analogy considered to be of affinity likewise. This is important, because upon this depends the length of interval by which we should separate these orders, which, if they are to be viewed only as curious imitations of each other, instead of cases of actual approximation, or a tending of Endogens towards Exogens, might stand indifferently at any distance from each other.

It is however probable, that there are many instances of pure analogy, where there is no affinity, between the plants of different classes, and different plants in the same class, an instance of the first perhaps is Lopezia and Orchis, Chenopodiales and Glumaceæ, Plantaginaceæ and Graminaceæ, Cycadaceæ and Palmaceæ, and of the second, Eryngium and Carduns, Salvadoraceæ and Chenopodiaceæ, Solanaceæ and Nyctaginaceæ, and in all of which the relation seems to stop with the mere resemblance. But where we find the most striking cases of this is in comparing the two distinct kingdoms of animals and vegetables: thus, there is a similarity to vertebrate and invertebrate classes in centrifugal Acrogens compared with the rest of plants; Gymnosperms are like reptiles in the fertilization of their ova, by direct contact with the pollen, and the two classes of Exogens and Endogens seem in respect to each other to bear somewhat the same relation as mammalia and birds. There is also a strong analogy with the animal kingdom evinced by the irritability of the leaves and other parts of plants, and some have gone so far as to consider Leguminosæ on the limits of the animal

kingdom on account of possessing the property in an eminent degree, but unlike the Diatomeæ of Algæ, there is no other character beyond this to indicate affinity.

It seems to me, that when we have made collections of plants into genera or orders, we shall find that they may be brought into alliance by two distinct modes; first, by gradual union, that is by the intervention of numerous species forming one or more orders or genera between two distinct species, as occurs in all groups considered natural, the second by direct union, or a sudden alteration and mixture of character between species possessing different distinguishing qualities and affinities.

When the second mode of union is discovered it is very satisfactory both that the two orders must be in alliance and in apposition, still we cannot call it the most genuine, for tribes are united in this way which have often little else in common; hence before the discovery of the link we may not only be unable to presume its existence, but also to appreciate the length of the interval separating the allied families. Cistaceæ and Papaveraceæ are instances of this, which though they have certain resemblances tolerably well indicated, differ so much in relation that their affinity could not be allowed till Dendromecon was discovered. By the first mode however, the alliance being effected on a broad and extended basis, families are seen approaching by a gradual amalgamation of character, so that we can foretel their connexion, even though the order which directly unites them may not have been discovered.

e. f.
Fig. 1. A. B. C. D.
g. h.

Thus if A. (fig. 1.) be an order united to another, D. through B. and C. the collateral alliances e. f. g. h. maintaining the same relationship, although not in the direct path of union, it is easy to perceive that A. is related to D. although B. and C. may not be known to exist.

Fig. 2. A. B. C. D. E. A. x. E.

But if A. and E. (fig. 2.) be supposed related on account of analogy, we cannot tell whether B. C. and D. must intervene to bring them together, or whether that may be accomplished simply by means of x. What may be the reasons for this, or whether there may not be another mode of explaining these instances we shall discuss hereafter.

But this instance will show us that orders presenting marks of analogy are liable to become really allied; in the absence of the actual proof of which we ought closely to inspect their respective affinities, which if we find tending towards each other we may venture to place the analogous orders in approximation, in the hope that at some future day a species may be found out which will afford a direct transition.

And the same course ought probably to be adopted when the general resemblance between two orders is such

as is only to be found between them and in no other part of the vegetable kingdom, as is the case with Rosaceæ and Ranunculaceæ, Cistaceæ and Papaveraceæ, Scrophulariaceæ and Lamiaceæ, Solanaceæ and Convolvulaceæ, in which although the obvious similarity is greatest between the orders here mentioned, the real affinity appears to be accomplished through the medium of their respective allies. A diagram will perhaps enable us to place the foregoing observations in a clearer light.

Rosaceæ.

Calycanthaceæ. Saxales.

Anonales. Umbellales.

Ranunculaceæ.

Now in the two orders placed in the centre some species are contained which are so strikingly alike that a person unversed in botanical distinctions usually mistakes them for members of the same genus, such as Ranunculus and Potentilla, the presence of stipules and the adhesion of the stamens to the calyx alone forming any visible marks of distinction; but these differences trifling as they may appear, and the more obscure characters of the embryo show us these orders need some connecting link: on the other hand, a gradual merging of these characters is to be found through the Umbellal and Saxal alliances; thus, the epigynous structure of Umbelliferæ remains at last the sole distinction between that order and Ranunculaceæ, and through Cornales and Saxales, the exalbuminous embryo and stipules of Rosaceæ are approached; the grand points of difference

between Calycanthaceæ and Winteraceæ consist in the same particulars as form the principal objection to the approximation of Rosaceæ and Ranunculaceæ; but the qualities from which we presume their association may be effected are almost peculiar to these orders, such as the chocolate coloured flowers with sepals and petals insensibly confounded, and their adnate anthers bursting outwards, a great character of the Anonal and Ranal alliances.

The orders named in the top line appear then almost exact imitations of those in the bottom one, but though there is a close approach in character there is not a complete union, they are like circles touching each other, but though they touch they do not unite, yet as we find not only the orders in question, Rosaceæ and Ranunculaceæ, but the allied tribes of each maintaining a similarity, it seems scarcely possible to disconnect them and place them in distant parts of a system since we find in them a circle of affinity, and their existing differences are liable at any time to be set at nought by the discovery of a plant which shall unite the organization of both, exactly as Cistaceæ and Papaveraceæ have been rather unexpectedly found to be allied by the discovery of Dendromecon. One single species discovered between Calycanthus and Illicium with hypogynous stamens in the order of the former, as is found in Saxifragaceæ, or exalbuminous, in that of the latter, as Nelumbiaceæ is in the Albuminous group, would render the affinity no longer questionable; the transition is almost as easy between Rosaceæ and Ranunculaceæ; between Umbelliferæ and Ranunculaceæ it is already sufficiently recognized.

But the epigynous character of the Umbellal alliance might be made as serious an objection to the association of that order with the rest of Albuminosæ, as of Albuminosæ with Rosaceous orders, but for the general resemblance in structure and properties existing between Ranunculaceæ and Apiaceæ. Till the value of characters therefore shall be more clearly ascertained, it does not appear that we can ground our ideas of affinity on a firmer basis than this general similarity, which in the orders above-mentioned and in many others in different parts of the system, is such as ought to prevent us from separating them from their analogues, even were their allies, which tend towards each other in so many points, not yet discovered.

Arrangement of the Affinities.

We must now endeavour to invent some mode of arranging the species of plants, some form which will allow them to stand side by side according to their natural relationship, and in which, approximation in position will be an indication of approximation in structure. We shall then become aware to what a length some of the characters distinguishing any collection are prolonged, gradually melting away, diffusing themselves over such a wide extent as would almost induce the belief that the affinity of species is universal; we must not however judge every species allied which possess some characters in common, but endeavour to discover whether that is not neutralized by the presence of some stronger characteristic. I cannot help comparing this intermixture of character to the appearance produced on

the surface of still water by dropping in a number of pebbles, the undulations occasioned by each stone becoming fainter as they depart from their common centres, but still those from each are plainly discoverable within the neighbouring circles.

We have before alluded to the fact that there is not a plant, excepting in a few species the causes of which are obvious, which we can take in our hands without perceiving it to be surrounded on every side by links of allied species. It is this and the gradual amalgamation of character consequent upon it, which leads to the conviction of the insufficiency of our characters and that orders and genera are mere artificial terms of which "Nature herself, who creates species only, knows nothing."

Yet it was a canon of the Linnæan school, that genera, the only groups which they acknowledged, which were not in the strictest sense of the word artificial, were really founded in nature. To be found in nature they certainly are, and as collections of natural objects, provided they are assembled with sufficient art and discretion, they certainly form natural groups, for it is not the assemblage of species but the division of genera which is unnatural. "It is absurd to suppose," continues the same eminent author from whom the passage above is quoted, "that our genera, orders, classes, and the like, are more than contrivances to facilitate the arrangement of our ideas with regard to species; a genus, order, or class, is therefore called natural not because it exists in nature, but because it comprehends species naturally resembling each other more than they resemble any thing else."

But we are not called upon by these statements to

allow that the vegetable system is an unarranged mass made up of unmeaning units which conduce to no end beyond that attained by their separate and individual existence; we cannot suppose them to imply that the extraordinary resemblances which are observable between species, by means of which genera and orders are constructed, are of no signification in an extended view of the subject; but merely that it is beyond our power to limit strictly these collections, to contrive characters for one group which nature shall respect in another, to regulate her eternal variety by any fixed standard of comparison. And even if ordinal and generic divisions be entirely artificial one can scarcely help coming to the conclusion that the greater classes, as Exogens, Endogens and Acrogens, have something of a natural character.

There is something which seems to give support to such a notion, and even to the idea that in the work of creation these classes must have been kept in mind, which is, that in the numberless ages which appear to have elapsed since the beginning of the world, although species have become extinct until not one either in the animal or vegetable kingdoms is the same as those of the primeval inhabitants of the globe, yet the systems are still divisible into the same great classes; the same pattern is still to be traced in nature's work though the web is woven with threads of different quality or complexion. And the individuals composing these classes are capable of being assembled under each of these three great types of structure independently of the rest, yet if the collection be carefully and naturally made they all join together into a symmetrical whole, of which, although the materials

may have from time to time decayed and been renovated, appears to have preserved its general stability and original design.

Every work that is written on the natural system of Botany endeavours to place its orders and genera in as natural a series as possible, but it is now generally acknowledged that that series is not linear, and therefore it is impossible to accomplish that object upon paper. Even though a circle of affinities may be truly expressed, we must remember that in so doing we are exhibiting quite a partial view, in fact the section of a sphere, for circles of affinity may be traced in every direction, both above and below the plane of the section. Hence we must conclude, that any form intended to represent the vegetable system must be solid; as such we shall consider it, and that it must have two extremities or poles, a superior one and an inferior, and that plants obtain a rise in organization exactly in proportion as they depart from the inferior pole. That is all that need be determined at present, unless it be this, that except in as far as is the necessary consequence of species, and the groups of them being surrounded on all sides by hosts of allies, it does not appear that the scheme of affinity is either irregular or confused—that is, I suppose it capable of being represented. For instance, supposing we had all the species of plants at our command, which we might be capable of arranging with unerring perception of their real relationships, if we then succeeded in proving the species A. to be in a great group or division X., and B. to be another species in the division Z., if a division Y. should come between these two and completely separate

them, then the species A. could have no affinity with the species B. This amounts to the same thing as saying that a body cannot be in one place and another place at the same time, or if a species is surrounded with its own affinities, it cannot also have affinities in a distant part of the system. It is true that this is only grounded upon the presumption that the relationships of plants are disposed in a regular manner; but for that we have something like proof which will be hereafter shewn, without which it would be just as reasonable to argue that the resemblances and alliances were without any order or regularity; but they really are found to present the same indications as though a certain number of centres had been created, from which rays had proceeded, which had united these in the most exact and natural manner possible, so that the vegetable species assembled into the system they compose might be represented by the decomposition of light by the prismatic spectrum, where the primary colours are gradually blended into each other, and their general point of meeting is accomplished by the white light in which all the rays are united. Were the similarities between plants otherwise arranged, it would be impossible to contrive any plan of delineating them or describing them, except as to the facts of individual connexion. It would be equivalent to saying that B. in its natural position stands between A. and C., but it also stands between A. and Z., and between R. and S.; it is quite clear that extending such irregular affinities to all the species of the vegetable kingdom, that the arrangement of the whole would not only be beyond measure intricate, but contradictory and impossible.

Now on the presumption of a regular gradation of organization, and assuming that a species or natural group once completely enclosed by its allies is properly placed, and requires no other position: it is evident that if we established some starting point, and from this go on placing tribe upon tribe, guided by the affinities they reciprocally bear, and continue to extend our solid form in height and breadth equally and correctly on all sides, we ought at length to complete our labours by arriving at the opposite extreme. This we might in such a manner expect to discover, even if we could not point it out before-hand, provided we could in our plan of arrangement attain a sufficient degree of accuracy in determining the places of plants. But this is expecting more than could well be fulfilled, for the alliances of the vegetable kingdom are by no means to be considered as settled, amidst the variety of opinions which prevail on this subject among the best authorities. Parts of the system so far as our knowledge goes, are likewise imperfect, and our arrangement being relative, defect in any position will affect all the adjoining parts.

It is worth entering upon the question, whether the affinities being regular, if the grades of organization are regular and proportionate to each other, that is to say, if A. is a species or order at one extremity of the system, and Z. the same at the other, if it should take twenty-four orders to unite them by one direct path, whether it would take the same number in another road as direct, but lying through different species or orders. If any thing like this be the case, as would seem warranted in some degree by the circumstance of the technical

divisions of Exogens and Endogens, agreeing in numbers with the typical figure of their classes, we must naturally expect it to run throughout all the divisions, of which the consequence must be, that every class must have so many groups, every group so many orders, every order so many sections, every section so many genera, and every genus so many species. But it would not be by this required that each of these divisions must have the same number of minor divisions, but only that their numbers should be proportional, or some multiple of the original number. Now if this be the case, we may expect every group to contain nearly the same number of orders, and we can assume any well marked instance of generic or ordinal difference where few individuals are found, to be as valuable and important as if the same abounded in genera or species: however fanciful the former proposition may be, the latter is well acknowledged; orders as Nepenthaceæ are founded on this presumption, and the propriety of the proceeding is apparent in such as Melastomaceæ, constructed originally on a few species, and now so much augmented by new discoveries.

With these premises we shall now endeavour to describe the system of vegetable affinities as a solid, tapering towards each extremity or pole from a line drawn round it, dividing it into two equal parts, these positions again equally divided will give us four stages, or as they might be called parallels of latitudes or zones. The lowest, or first of these, will be made up of Acrogenous plants, the second will contain Endogens and imperfect Exogens, the third the Polypetalous plants of the last class, and the fourth, or highest, the Monopetalous. Thus

z.

Monopetalæ.

Polypetalæ.

Endogenæ. Incompletæ.

Acrogenæ.

a.

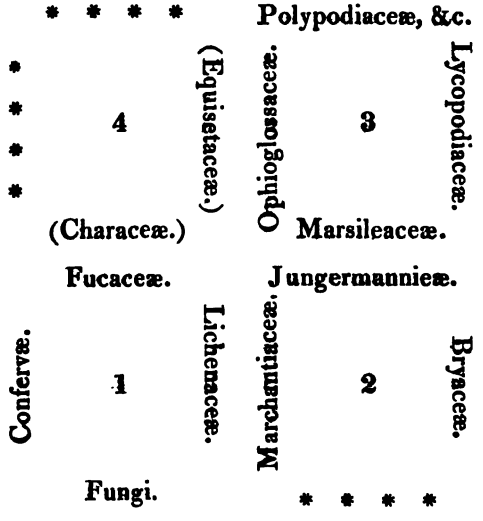
It is here assumed, whether correctly or not I leave others to determine, that the positive height or extent in direction of the polar axis a. z. of each of these zones is the same, therefore an equal degree of rank is supposed to be accomplished by the species of each; but this is a matter of very little consequence providing that the respective relations are unaffected thereby, and it must be borne in mind that after all, this form as well as those which will hereafter be proposed is merely imaginary, and is only intended to show what might, not what really does exist in nature, being analogous perhaps to the musical scale and notes by which the modifications of sound called tones or notes are indicated. Though I shall not at present attempt to define the figure of the above plan more closely, I shall assume that a section of it at right angles to the polar axis will be circular.

Acrogenous Zone.

From the common point where the animal, vegetable, and perhaps mineral kingdoms meet, we shall consider that vegetation commences by the tribe Algæ or the Sea-weeds, to the former kingdom the approach is manifested in Fragillaria, Diatomia, Oscillatoria, &c. and to the latter by such Diatomeæ, as Agardh states, "include vegetable crystals bounded by right lines collected into a crystalliform body, and with no other difference from minerals

than that the individuals have the power of again separating." The lowest forms of Algæ may be separated completely from the rest of Acrogens, and considered to occupy the polar half of the space allotted to that class, but it is probable that certain Fungi, as Byssaceæ ought to be placed likewise among these simple forms of vegetation. But we shall at first endeavour to retain the orders and groups of them in the same integrity and position as is generally allowed to them, and from placing them together in this way we shall perhaps be enabled to discover such deficiencies as we may endeavour hereafter to rectify. Let it be understood then, that the Acrogenous zone is divided into two parallel sections, of which Algæ occupy the inferior, and the rest of Cryptogamia the superior.

The relations of these superior cryptogamous plants appear to be pretty well expressed in the following diagram.



In this diagram, represented in a square instead of circular form for greater convenience, and bearing the same relation thereby as a chart does to a map, we are supposed to look upon a section carried through the centre of the superior acrogenous zone, and we are called upon to allow for the present that the orders here represented, at any rate some of the plants they contain, are situated on the same parallel, or are equal in rank, and the same must be allowed in all the diagrams remaining to be shown, where in truth it will be more applicable than in the present instance. But I wish, in the first instance, to place the orders of plants together in such a manner that the usual groups of them may not be disturbed. Thus in the above scheme, group 1 is the Fungal alliance—2 the Muscal—3 the Filical and Lycopodial—and 4 Equisetaceæ, with the Charal alliance of Lindley.

Now whatever deficiencies really may exist in this and the following plans, it is supposed that by taking a plant at any point, we can trace by almost insensible gradation, a circle from it in any direction, and to any extent, back to the same again. With respect to the division into four, which may appear rather arbitrary and opposed to such a gradual intermixture of character, it must be understood that supposing we here have species placed correctly, it is a matter of very little consequence in which direction the division is effected. For instance, the plants not altering their position, let the lines be drawn through the angles instead of being parallel to the sides of the figure; we might then place the names of the orders to be found on those lines with equal truth and propriety as

those which are placed in the diagram. In respect to the divisions being represented all of equal magnitude, some little latitude must be allowed on that point, as has been before adverted to in page (61.) Nor are the orders named here supposed to be confined to the very space their names occupy. Those enclosed in ( ) are more or less isolated.

The circle of connexion may thus be traced; suppose we commence from Fungi, the transition to Lichens is very palpable in such genera as Sphæria and Peziza on the one hand, and Calycium, Verrucaria, or Opegrapha on the other; between Lichens and Marchantiaceæ, Ricciæ and Endocarpus form the connexion, and Andræa unites Hepaticæ and Mosses; Lycopodiaceæ, the last with Ferns; and these are supposed to have some connexion with Equisetaceæ; Charales by their habit call to mind the last named order, and though an order more problematical in position than perhaps any other, have been considered to have an affinity with some Confervæ; the transition from Algæ to Fungi is apparent in Byssaceæ; thus the circle is complete. The connexions of the individuals of the groups are too apparent and well acknowledged to require description.

It may be as well to say a word or two in this place on the natural characters which might distinguish these groups. The first division that may be effected is into plants with an axis and those without an axis; the latter will be the chief character of the Fungal group and its allies. Leafy with an axis and without vessels will represent the Muscal. Leafy with vessels, the Filical, (gr. 3.) Leafless with branches verticillate, the Charal, (gr. 4.)

Although on the whole the species of this class maintain considerable relation with each other, it is impossible not to perceive the existence of some chasms; we know that entire genera, even if they were not orders, as Lepidodendron and Calamites which once existed have disappeared. Geologists measure out the steps of time for ages back by the duration of species; if we could suppose that the extinction of forms of organization had any signification, it would seem to show that a class where the obliteration had proceeded to such an extent, must have been more frequently exposed to the march of the invader, than those the units of which continue to represent their prototypes; and consequently, that the creation of the former must have been of more ancient date.

Incomplete Zone.

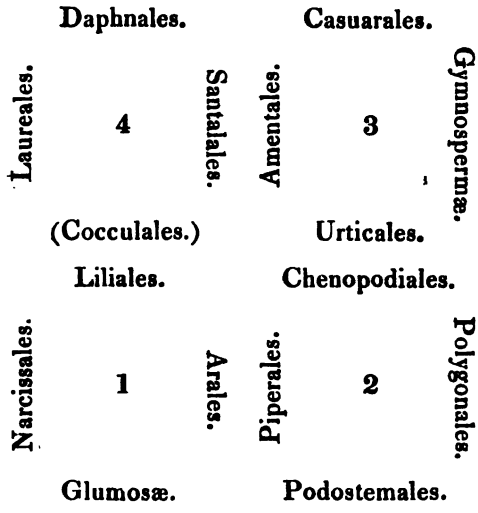
After we pass the line which separates Acrogens from the rest of vegetables, we find that two very different classes of plants rest on these, or if we choose so to express it, take their origin from them; but the floral division of plants, arising by these two classes does so by very different paths from opposite extremities of the system; Endogens appear to have a connexion with the lower Acrogens, and Exogens with the higher tribes. Thus the group of Rhizanths, which is by some considered a separate class, is supposed to bring Araceæ in contact with Fungi; and although this curious case of affinity is disputed, it seems corroborated by Fluviales and Pistiaceæ, shewing a connexion of flowering plants with Cryptogamia of almost as low a grade, as

Marchantiaceæ, &c. Although Exogens are principally allied to Acrogens by Casuaraceæ and Equisetaceæ, Cycadaceæ and Filicaceæ, Coniferæ and Lycopodiaceæ, yet Podostemaceæ, which seem to bear the same relation to Fluviales as Piperaceæ do to Araceæ, seem like Fluviales to have a strong analogy with Hepaticæ.

It seems then a natural inference that even at their root the two classes of flowering plants are collateral and closely approximate, as they are in their subsequent progress towards the superior pole of vegetation. This is evident from every group of Endogens from the lowest to the highest having an evident alliance with some orders of Exogens. Thus Naiadaceæ must be considered connected with Podostemaceæ, Araceæ with Piperaceæ, Typhaceæ with Saururaceæ; by Taccaceæ Araceæ possibly approach Aristolochiaceæ, Smilaceæ join Menispermaceæ, Alismaceæ Ranunculaceæ, Butomaceæ and Hydrocharaceæ Nymphæaceæ. Now it will be observed that all these orders of Exogens here named belong to the incomplete series, excepting only Ranunculaceæ and its allies, if then Endogens have any plants on a parallel with more exalted Exogens than these, there does not appear to be any further connexion between the classes, so that they must be looked upon as diverging from that point in different directions, unless as appears most probable, the course of Endogens is there terminated. Now Ranunculaceæ are very far from possessing such organization as can entitle them to be placed among the highest in the exogenous class, on the contrary they appear to be one of the least perfect tribes of the polypetalous division.

It therefore seems fair to suppose that the highest monocotyledonous plants are only on a level with the lowest polypetalous dicotyledons, or what is the same thing corresponding in dignity with the superior species of the division of that class called Incomplete. Endogens will therefore be considered as an integral portion of this zone, which will be understood to extend from Acrogens to the lower species of the polypetalous zone. At the line of union of the Incomplete with the polypetalous zone, we may suppose that the vegetable system attains its greatest lateral extent, and one half its extent in the direction from one extreme to the other, and hence this line of separation may be denominated equatorial. Let us now see what kind of plants occupy this position, or Incomplete division. It is supposed, as before observed, to include the whole of Endogens, and we have before alluded to the idea that the production of petals was to be looked upon as very essential in conferring rank; now in surveying the species placed in this zone we shall find a gradual attainment of floral envelopes from the absolutely achlamydeous Podostemaceæ, Piperaceæ, Callitrichaceæ, and the lower orders of the amentaceous group, to the rudimentary calyx of some Urticales, to the more perfect envelope of the higher orders of these, and of Chenopodiales and its allies, to the tubular form and corolline texture which we find in Daphnales and the neighbouring orders. Whether any apetalous orders included in Polypetalæ deserve a place here we shall hereafter examine, but there can be no doubt of the propriety of separating these imperfectly formed Dicotyledons from the rest of the system.

The arrangement of the established groups of Incompletæ may be thus accomplished.



The four divisions here shewn are thus constituted. 1, is the monocotyledonous class. 2, the Curvembryous group and some Achlamydosæ. 3, the Rectembryous group with Gymnosperms. 4, Tubiferons group with Cocculales. Now the transition from Endogens to Exogens is here expressed by the position of Araceæ and Piperaceæ, Piperaceæ are connected with Polygonaceæ, Polygonaceæ and Chenopodiales with Urticales, Urticales with Gymnosperms, Amentales and Casuaraceæ by Garryaceæ and Myricaceæ; with group 4, the relation is not very apparent, but Cocculales certainly join Smilaceous Endogens; thus a circle though somewhat imperfect is formed. Upon comparing this diagram

with that of the acrogenous zone, it will be perceived that the natural relations of the plants contained in the two are not violated; thus it is apparent that Endogens can join with the Fungal group of Acrogens which are their natural allies. Podostemales stand over the Muscal alliance, and Gymnosperms over the Filical; Casuaraceæ stand perhaps rather too far from Equisetaceæ.

But it is impossible to view this group and not to be aware that the connexions usually subsisting between the members of the vegetable kingdom are less apparent here than in almost any other department. It is much to be regretted that this is on account of the little attention hitherto paid by botanists to this class: which is owing to the species being less showy in their appearance than those of the other divisions; but no collection of plants can be compared with this for containing such curious and singular specimens. It will be sufficient to mention the orders Aristolochiaceæ, Nepenthaceæ, Menispermaceæ, Nyctaginaceæ, Proteaceæ, out of many others, to show that this opinion is not unfounded.

This little studied division of plants will probably require entirely remodelling so far as its groups are concerned, but if it is worth while to indicate any common character of each as they stand in the diagram, the second may be in general distinguished by its hermaphrodite flowers, and calyx imperfect or wanting; the third by its unisexual flowers, and calyx also imperfect or absent; the fourth by that floral envelope being tubular and considerably developed. This last group requires to be placed in the highest parallels of this zone, for no doubt can exist that it is among the most highly organized of the plants

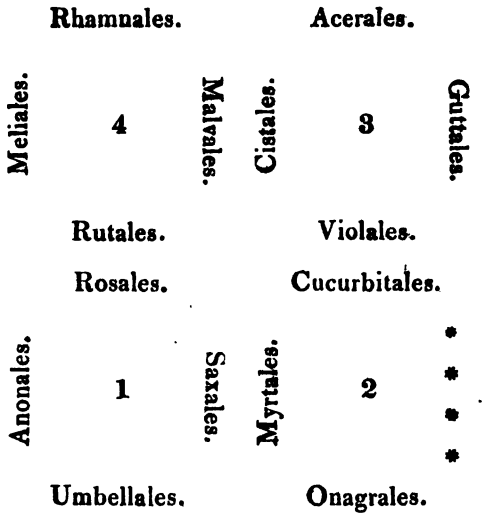
herein contained, and as it stands there is no manner of connexion with the lower tribes, or any passage to the inferior zone, it will either require breaking up and distributing in the manner above suggested, or it is not impossible that it may require complete removal from the really apetalous orders to the lower stations of polypetalous plants. The only alteration I have here presumed to make is in the achlamydous group of Lindley; Salicales of which are supposed to be placed near Amentales, and Moniniales near Laureales; where Callitrichaceæ should stand is very doubtful, all that is determinable of it seems to be that it is on the limits of flowering and flowerless plants.

Polypetalous Zone.

After we have passed the mesial line of vegetation, which appears to lie between the Incompletæ and polypetalous zones, the forms of Exogens assume a very different aspect; the calycine leaves are no longer depauperated, but well developed and frequently combined into a tube; the petals are present, of such size and texture as renders them objects of great beauty, in fact more so in this section than in any other. Yet notwithstanding this, and the remarkable property of sensation in the leaves of some species, the arborescent stature of many, the great number of individuals here assembled, and the variety of organization they exhibit, Monopetalæ for the reasons before advanced, and by the proof of position by affinity, must be allowed to be really superior in dignity to these. We must only regard

these qualities as one of the many instances of compensation to be found in nature, and we ought no more to be astonished at them, than that the instincts and perceptions of the inferior animals, taken separately, are often manifested in a much higher degree than those of man.

The arrangement of the polypetalous group has always been considered difficult, on account of the great number of plants referable there, and also we may suppose this to be increased by their standing between the monopetalous and apetalous sections, and consequently partaking sometimes of the characters of each of these. But the groups of Dr. Lindley seem to stand naturally in the following diagram.



The four divisions here represented are thus composed. Albuminosæ and Apocarposæ form the first; the second

is Epigynosæ; the third, Parietosæ and Calycosæ; the fourth, Gynobaseosæ and Syncarposæ. There is no want of connexion in the alliances of this zone, on the contrary the affinities which are manifested are puzzling from their nearly universal tendency. To commence from group 1. Umbellales are connected with Saxales by Hydrocotyle and Chrysosplenium, also perhaps by Grossales and by Cornales, which two alliances seem intermediate also between the Umbellal and the Myrtal and Onagral, this last is connected with the Cucurbital by Loasaceæ, these touch closely on the Passional by Passifloraceæ and Papayaceæ, the Passional is scarcely to be distinguished from the Violal, these are intimately connected with the Cistal and to the Aceral by Polygalales, also to Geraniales and Silenales; the Cistal is allied to the Malval orders by Chlenaceæ and Hugoniaceæ, which last tribe seems to touch also upon Oxalidaceæ; Malvales are intimately connected with Rutales and Rhamnales, and the allies of these; Rutales join Meliales by Xanthoxylaceæ and Aurantiaceæ, and these alliances touch on Fabales and Balsamales leading thus to Rosales, and also by Pittosporaceæ and Olacaceæ? to Anonales. Anonales join Umbellales by Ranunculaceæ and Berberaceæ, and by Dilleniaceæ and Pittosporaceæ; Pittosporaceæ which are stationed here touch Umbellales by Vitaceæ; thus we arrive at the point from which we set out. But numerous as these affinities pointed out are, but few of them evidently existing among the plants here stationed are enumerated; but it is needless to pursue the subject any further as future observations upon it will be required.

We may however notice that the groups here delineated

seem to be more on an equality than any we have before seen, as they are, with the exception of the second, made up of two distinct established groups; it is almost unnecessary to give them any general character, especially as I intend to substitute a different arrangement, but no harm can result from directing attention to any natural characteristics. As we have considered adhesion to be a very important character in raising plants one above another, I once conceived that it might in a different way be rendered useful in distinguishing these groups from each other, thus if we commence from the centre of group 1, we shall find there a collection of orders constituting the Ranal and Anonal alliances, in which there is a remarkable tendency of all the parts to preserve their separate state, the sepals, the petals, the stamens and carpels, showing little or no tendency to adhere. On the side of these next group 2, the Umbellal and Saxal alliances, although with inferior ovaria, still keep their styles distinct; in group 2, the tendency to adhesion is completed apparently in every part; group 3, where the petals or stamens frequently, and carpels always adhere, shows a remarkable separation of the calycine whorl or the carpellary leaves are only united by their edges, so that the placentation is parietal; in group 4, the sepals are tubular, the petals showing an approach to the monopetalous form the stamens very often monadelphous and the fruit most times syncarpous, where it becomes apocarpous it constitutes a passage to the Rosal alliance of group 1, the tubular calyx and perigynous stamens of which form almost the only distinction between their species and Anonales. This appears to indicate that if

the orders here arranged are not in their most natural position, they certainly show an approach to such a position.

It now only remains to trace the connexion between the diagram of the Incomplete zone and that at present before us, group 1 is connected with Endogens in the Incomplete zone by Ranales, and with Laureales by Anonales; group 2 joins the corresponding collection beneath by Mesembryaceæ and Tetragoniaceæ, and Combretales and Santalales. Halorageæ seem to indicate some affinity with the incomplete orders, but to what in particular is not apparent: group 3 seem to communicate with Chenopodiales by Silenales; group 4 by Rhamnales and Daphnales. What may be the signification of the numerous apetalous plants to be found in this division remains yet to be discovered, that they indicate an inferior state of development cannot be doubted, but whether they form a separate assemblage between the polypetalous and the really incomplete group is not so certain.

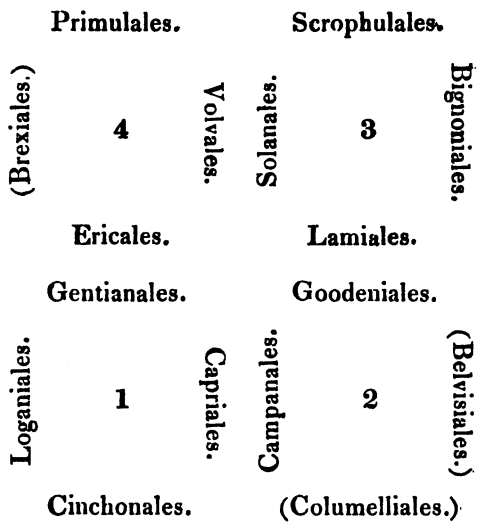
Monopetalous Zone.

We have now come to the consideration of a group of plants which have always been considered as of a somewhat isolated nature, maintaining more connexion among the species of their own tribes than with those of any other division. Such must necessarily be the case if the position I assign to them, which I am not aware has ever been given to them before, be correct, for if reference be made to the diagram at page 61, it will be seen that the only species they can be expected to afford evidence of

alliance with will be the highest in the series of Polypetalæ. Shall I add to this and the arguments before advanced upon this subject, the superior medicinal properties of this sub-class as confirmatory of their position, and evincing by the augmentation of the powers of secretion the necessary consequence that a more elaborate organization must be required for that purpose. It is almost superfluous to insist upon the obligation Physic owes to a class which affords the powerful tonic of Cinchona, the emetic Ipecacuanha, the bitter Gentian, the fragrant Mints, the powerful sedatives Digitalis, Hyoscyamus, Solanum and Belladonna, the acrid Capsicum and Lobelia, the vermifuge Spigelia, the powerful principle of Strychnos and Upas, the balsamic Styrax and Benzoin, the stomachic Chamomile, the anodyne Lactuca, the sweet gentle purgative Manna, the strong cathartic Jalap: in fact there is scarcely an order which does not contain a majority of species which might be applied to some medicinal or economical purpose.

In the same manner as Algæ and the plants bordering upon them required a separation from the rest to the polar extremity of that zone; so does it appear that Asterales do in this as has been advocated before, and it will here be perceived that the group Compositæ has no other connexion than with the highest plants of the present section, no order which is not in the strictest sense of the word monopetalous can be found to afford any signs of relationship.

The affinities of the inferior synpetalous plants may be thus expressed:—



Of the groups thus formed 1 is made up of part of the dicarpous and epigynous groups of Lindley, and may be characterized by the opposition of the leaves; 2 is the remaining portion of Epigynosæ; 3 is Nucamentosæ and part of Dicarposæ, which may be characterized as dicarpous; 4 is Polycarposæ. The connexion subsisting between these orders may be described in this manner—commencing from Cinchonales we pass to Capriales, which scarcely differ. Columelliales are supposed to have some analogy with the Cinchona tribe, from Caprifoliaceæ to Campanulaceæ Linnæa appears to form the link. Scævolaceæ in Goodeniales is thought to be analogous to Lamiaceæ, at any rate Gesneraceæ in the dicarpous group appears to approach the epigynous orders. Boraginaceæ and its allies unite Volvales most

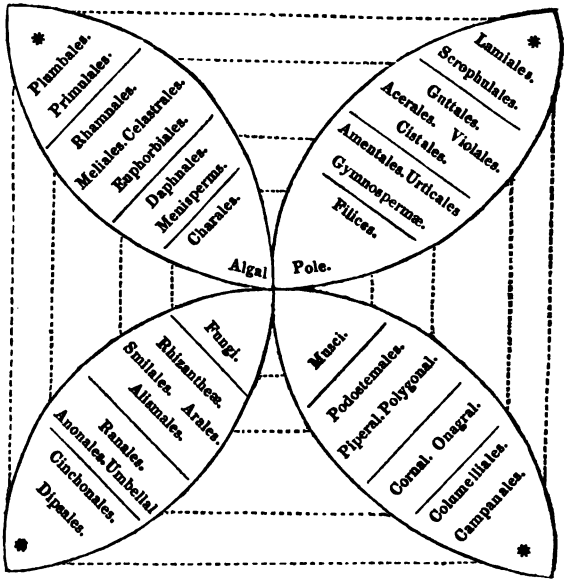
closely with this group, Solanales touch on Primulales, and these are connected with the whole of the Polycarpous orders. Ericales may be considered allied to Gentianales by the leafless parasitical species Leiphamos in the latter alliance to Monotropaceæ in the former, and most probably to Orobanchaceæ in the Scrophulal alliance; from Gentianales to all the assemblage of the first group the transition is most easy and natural.

Regarding the connexion of this zone with those above and below it, it appears to be thus, Cinchonales join Umbellales by Galiaceæ, and Saxifragaceæ and Cornaceæ by Caprifoliaceæ; Gentianales are approximated to Myrtaceæ by Melastomaceæ; Columelliaceæ seem to have an affinity with Onagraceæ, Belvisiaceæ with Passifloraceæ, and Cucurbitaceæ; Acanthaceæ with Polygalaceæ, Primulaceæ with Rhamnales by Aquifoliaceæ, and Ericaceæ with Rutaceæ, with the superior or asteral portion of the zone, they are connected by the alliance of Cinchonales, Campanales, Lamiales and Primulales with Compositæ or the orders nearly allied to them, and distinguished under the general term Aggregous, which are here viewed as forming the polar extremity opposite to that from which vegetation commences by its simplest forms.

We have now completed an arrangement of the vegetable kingdom according to the principles laid down in the foregoing observations on the Rank of Plants, whereby Complexity and Concentration as manifested in the production and consolidation of the floral envelopes have been looked upon as essential in determining the stations of plants in their degrees one above another.

So far it is in accordance with a systematic method that has been for some time in use with botanists, and which has not yet been supplanted, corresponding with the division of Exogens, to say nothing at present of the other class, into Achlamydeous, Apetalous, Polypetalous and Monopetalous. From what we have hitherto determined it does not appear that these groups can ever be abolished, for as far as they go they certainly appear to be founded in nature. But there is no doubt that they have respectively been considered of too much importance. It has been assigned as a sufficient proof of such an order having no relation to such a one to say that one was monopetalous or polypetalous which the other was not. The effect of this has been to distract attention from the connecting points of these sub-classes, and to make them appear more isolated than they really are. Whether they are as intimately connected with each other as the orders of each are among themselves is a question which we must hereafter consider, but a sufficient number of transition cases have been discovered to dispel the idea, if any such existed, that any definite boundary could exist between them. The objection urged against them of their characters not being constant, is, I think, less applicable to these than to any other collections, if we consider them disposed in the manner I have represented, and the instances of partially united petals, as Ericaceæ, Rutaceæ, Crassulaceæ, &c. to be in effect something intermediate between the more decided characters assumed by the species situated more centrically in the groups. The more abundant exceptions of absence of petals in Polypetalæ might no doubt, if

investigation were instituted, be found to present the same relations with the Incomplete zone. A more serious imperfection in these sub-classes, and one which seems to be the cause why botanists are becoming impatient of such an arrangement, may be, that they separate the vegetable kingdom into such a small number of divisions as to render it absolutely necessary to find some other mode of forming natural sections. Now it will have been observed that in all probability the line of division of these groups is at right angles with the axis of development, (p. 61.) and hence it is necessary that the sections of the system formed by these parallels must not only contain a very large multitude of individuals, but also a great number of types of organization. If any great characters could be traced in a direction contrary to this, that is parallel with the axis, (a. z. p. 61.) it would afford not only the means of showing the path by which a species may be traced from below upwards, or the contrary, but an accurate method of ascertaining more immediately the place, that is, the affinity and character of any given plant, the lines of direction of these two opposite methods intersecting as the lines of latitude and longitude are made to do upon the terrestrial globe. It is also evident, as will appear hereafter, that what may be called the tracts of organization really do proceed in such a direction, as will appear by our taking a general view of the vegetable system, as we have supposed it to be represented by the diagrams of the zones.



We have hitherto not defined the figure by which we have represented the vegetable system more closely than to say that it had two opposite extremities, and that a section of it at right angles to the poles might be considered as circular. We may, however, probably assume that the whole may be represented by a sphere or some figure not very different from that. In such a form every part would be removed as little as possible from the common centre, and in confirmation of such an opinion it may be mentioned that Polypetalæ, which are stationed by the equatorial line, contain a far greater number of orders than Monopetalæ, and Incompletæ may claim the same thing with regard to Acrogens, if it be considered

that Endogens are collateral with them; so that it is in some measure warrantable to consider that the lateral extent of the vegetable kingdom is greater in the two central zones than it is in those at the extremities.

Now the diagram above is intended to represent a sphere divided vertically into four sections, but the section is here supposed only to extend to a certain depth into the interior, so that this may be regarded as an external shell removed from one or more concentric spheres in its interior. The reasons for such a supposition are, that if we turn to the diagrams of the zones, and consider the groups as they stand there, we shall find that they may in almost every instance be divided into external and internal. This is remarkable, at any rate in the polypetalous zone, where Apocarposæ, Gynobaseosæ and Parietosæ all stand internally with regard to Albuminosæ, Syncarposæ and Calycosæ; these will, therefore, with some others, be reserved for a separate examination, and considered for the present to form a smaller globe in the centre of the larger one above represented. This cut is not only intended to show at one view the connexions between the several zones, but also that I may point out by its means the existence of several particular forms of structure, or, as they may be called, tracts of organization, which proceed in a direction diametrically opposite to those we have heretofore considered, or, as we may express it, in the direction of the polarity of the system.

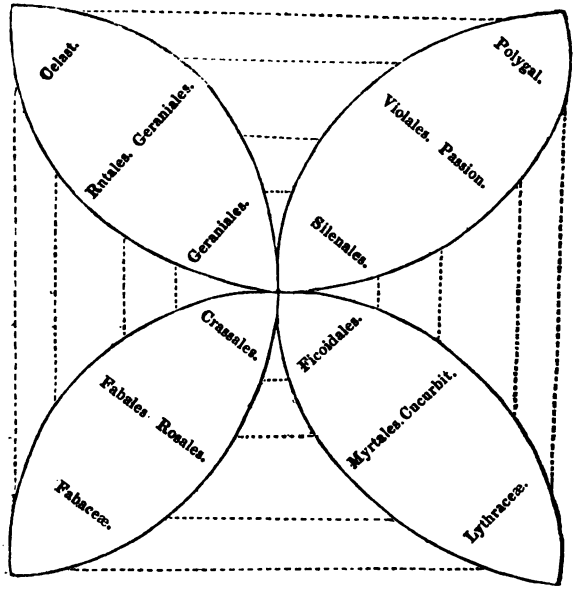
This is so apparent, that it is scarcely possible to look on the plan before us without perceiving that some of the characters contrived by Dr. Lindley for grouping together portions of the zones, ought in many instances to be

extended above and below the zone for which they were at first especially constructed. Thus the albuminous character of Ranales and its allies, and Umbellales and its allies, is equally applicable to Piperales, Monimiales, Menispermaceæ, Aristolochiaceæ, Cinchonales and its affinities, perhaps including Gentianales, and it is a circumstance well worthy of remark that these orders are none of them far removed from Endogens, which are almost without exception albuminous, I say almost, but it admits of a doubt if they are in reality ever exalbuminous, for in the orders called by Richard macropodal the disproportionately large radicle probably performs the same functions as the albumen, and by the same rule we might expect the same of the fleshy undivided embryo of Orchidaceæ. The epigynous structure of Onagrales seems to extend from Santalales through the polypetalous and monopetalous zones, even to Asterales and the diclinous structure of Amentales seem to be continued upwards by Euphorbiaceæ, Aceraceæ, Sapindaceæ, Clusiaceæ, and Ebenaceæ.

Here then are the traces of some peculiar characters which we shall enter upon at large presently, and these evidently comprehend a train of species disposed in a different direction from those we before took note of. It is unnecessary to describe the diagram further, as it would be merely a repetition of what has been before observed, but in the following one I shall direct attention to the complicated affinity of the centre of the mass. Any scheme intended to represent the connexions of plants ought to be so perfect that a circle drawn in any part of it should include in its limits no species without

an evident relationship to the rest. If, therefore, from the central point of any of these diagrams we were to describe a circle, the orders included ought to be scarcely recognizable from each other, if the centre of these groups really were the centre of the system. The polypetalous zone will afford as good an example as any of the rest; I shall therefore refer to that alone, and this single instance will be sufficient. It is to be remembered that we take it for granted that the position of the names of the orders placed in the diagram is sufficient to express each and every relationship of them and their allies. Let us put this to the test: Rosales have affinities with Myrtales which are expressed, as they have as well with Cucurbitales by Homaliaceæ, they appear to have some affinity also with Bixaceæ and Samydaceæ in Parietosæ, all of these we can, by inspecting the diagram, conceive to be accomplished. Next Myrtales appear to have relation to Malvales in the opposite side of the plan through Lythraceæ. Droseraceæ in Violales are supposed to approach Saxifragaceæ by Parnassia; Silenales, which appear to lie between Parietosæ and Gymbaseosæ, are connected with almost every order but those of Rutales and Fabales, Rosaceæ seem to approach to their allies by Neuradeæ and Crassulaceæ, Mesembryaceæ and Cactaceæ in Epigynosæ must be allowed to have a near relation with them, Violaceæ they approach, and Frankeniaceæ, Malvales by Linaceæ, and Geraniales by Oxalidaceæ. Leguminosæ must also be allowed to be in some degree allied to Moringaceæ, Polygalaceæ, and Trigoneæ. It is certainly possible to account for these apparently conflicting affinities, by supposing the unions

to take place, as they undoubtedly do, at different levels, as is represented in the following diagram.



This represents a sphere contained in the centre of the other, delineated at page 80, in which the affinities of Leguminosæ are attempted to be shewn at the part most remote from Silenales, these latter are supposed to be connected with their allies at the bottom of the figure, and the other relations are exhibited in the intervening portions of the diagram. Thus, by supposing the different orders here placed to come in contact with each other at various degrees of altitude in the system, we avoid the palpable error of supposing them to cross from one side to the opposite without uniting inseparably at their points of contact. But taking it altogether, the alliances of this

central mass are not sufficiently blended together to assure us that we have arrived at the right method of arrangement. But a more serious impediment to such a presumption is, that there are throughout the plan some affinities which are not and cannot be expressed; how are we, through the orders intervening in the centre, to bring Cistaceæ and Papaveraceæ into contact, or to express the alliance of Theales and Myrtales, Guttales and Meliales, or the latter with Sapindaceæ in Acerales. Some discrepancies will also be observed in considering the connexion of the zones one with another, which do not appear in some instances to be sufficiently direct, but I have in vain tried to arrange the orders so as to preserve entire the groups of Dr. Lindley, and at the same time to express the relations of plants in a more natural manner than has been represented. Notwithstanding this, I should have remained content with the manner in which the alliances are heretofore expressed, nor presumed to destroy the structure raised by so eminent a hand, had not the first blow to the arrangement been given by its own author. In the Penny Cyclopædia, article Exogens, the reader will find a system intended as a substitution for the former one, or at any rate intended to show that the writer does not consider his former groups sufficiently perfect. The class of Exogens is there distributed into five sections, which depend upon, 1st.—the quantity of albumen in the seed being larger than the embryo. 2nd.—the epigynous structure of the ovarium. 3rd.—the perfect unisexuality of the flowers. 4th and 5th.—in the monopetalous class the carpels being two, or more than two.

The curious circumstance of the number five prevailing in the parts of most Exogens, three in those of Endogens, and four in some Acrogens, might lead us to infer, not unreasonably, that some similar influence of numbers might affect the division of the vegetable kingdom. We find accordingly that the alliances of Exogens have lately been arranged in these quinary divisions, but the same mode of division has been extended to all the rest. Endogens, however, are primarily separated into six groups, I shall in this work attempt to carry out the principle, and it will be seen that the orders do not conform badly to such a plan. Mention of this brings us to a consideration of the ultimate structure of the vegetable system. This we have hitherto considered in the most simple manner possible, namely, as a collection of a great number of units, perhaps 100,000, into a spherical form, the only divisions proposed being the imaginary lines of section. So one species was supposed to differ from another in a minute degree, and the next from that to no greater extent, so that it required considerable removal from any given plant to make a difference of structure sensible; in this manner genera, orders, groups, and classes would be insensibly confounded together. This is one way of considering the matter, and if not the most correct, it is certainly the most simple, requiring less to be presumed than by a contrary method. But in future we shall however proceed on a contrary hypothesis, namely, that the classes of vegetables have a separate existence, and that the arrangement of these individuals is altogether independent of those of the neighbouring classes. The common mode of representing the con-

nexions of Acrogens, Endogens and Exogens, by three circles in contact with each other, will serve to give an idea of that which is implied. But however such a disposition of the classes cannot be regarded as strictly correct, for if they are represented by spheres touching each other the points of contact are not sufficiently extensive, and we have before proved that the approximation is not confined to a single species or order, but is apparent in several; all that I would suggest by such an instance is that the transition is sudden at the approximating points, in other words, that Alisma is less like Ranunculus than the species of the genus Ranunculus or Alisma are to their congeners. No one can fail to acknowledge the resemblance of Lemna and Riccia, but I am not aware that any actual transition has been pointed out; at the same time it is impossible to see vegetation reduced to the lowest state in which flowering plants can exist, and so great a likeness manifested to the flowerless class, without believing there is more than an apparent approach. Now if classes can touch on each other by such sudden affinity, it is necessary to suppose that the same law is applicable to their divisions. Hence the species of any group may be expected to exhibit more affinity among themselves than they do with the surrounding groups. Let us try orders by the test:—we are forbidden to suppose that an order really exists in nature, but it may be possible that it is merely the separation of it that is decried as unnatural, the existence of an actual line of demarcation is as much falsified by a case of sudden as of gradual affinity, and if we take orders as they stand at present constituted, do they not

offer fewer cases of transition than of intimate affinity. An order like Palms approaches the rest of plants only by about two genera. It is true that a genus is a collection of individuals, but even then a solitary species is often pointed out as the real tie, so that the connexion is accomplished by a point. The vast order Orchidaceæ departs from its peculiar structure by the two or three genera of Apostasiaceæ; so that orders seem really somewhat of the nature of spheres or circles, the circumferences of which come rather abruptly into contact with their neighbours. But we must not allow the habit of considering an order as something distinct to prevent our observing that in taking it to pieces in most instances we find it made up of very dissimilar materials, organization seems as it were constantly on the move, the different sections tending all to different points; but I do not think that this is sufficient to set aside the idea entirely, that there are two distinct modes of affinity as indicated before, a sudden and a gradual mode, an affinity of alliance, and an affinity of analogy.

The manner in which Dr. Lindley, in the diagram before alluded to, seems to have understood this question is a strong example of what I am at present alluding to. He has, in arranging the system on entirely new principles placed at the sides or connecting points of his groups analogical species, which in many cases appear to exhibit little or no affinity. I cannot presume to depart so far from customary methods, all I shall attempt is to suggest that there may possibly be tracts of organization in the classes corresponding in number with the typical figures of the classes, and that the transition between the

approximate sides of these tracts is made in a more rapid manner by species stationed there than it is between those in the interior of the group. Nor shall I find it necessary to interfere in any manner with the established groups founded on the nature of the floral envelopes, but only to offer a slight modification of the arrangement heretofore exhibited in the diagrams of the zones, and endeavour to trace the alliance of species, and the prevalence of some common characters, in a direction opposite to that in which the inquiry has been prosecuted before.

For the sake of brevity I shall therefore immediately proceed to exhibit such an arrangement in a tabular form, and offer such remarks as appear necessary under each class or group as occasion requires.

CLASS I.—ACROGENÆ. (Sexual organs absent.)

Group 1.—EVASCULOSÆ. (no vessels.)

All. 1.—*Fungales.* Plants leafless, without a distinct axis.

Algæ. *Char.* Fungi. *Rhiz.* Lichenes. *March.*

All. 2.—*Charales.* leafless, with an axis, branches verticillate.

Characeæ. *Algæ. Equisetaceæ.*

All 3.—*Muscales.* leafy, with an axis.

Bryaceæ. *Lycop.* Andræaceæ. Jungermanniaceæ. Marchantiaceæ. *Lich. Pist? Podost.*

Group 2.—VASCULOSÆ. (with vessels.)

All. 1.—*Lycopodales.* Vernation straight.

Lycopodiaceæ. *Bry.* Marsileaceæ. Salviniaceæ. *Jung.* Ophioglossaceæ. *Filic.*

All. 2.—*Filicales.* Vernation circinate.
Danæaceæ. Gleicheniaceæ. Osmundaceæ.
Polypodiaceæ. *Cyc.*
All. 3.—*Equisetales.* Branches verticillate.
Equisetaceæ. *Casuar.*

The names in italics after those of the orders represent the affinities which are most generally acknowledged; those of the orders in the same alliance are not indicated being obvious from their position.

In some previous remarks on the acrogenous zone, I mentioned it would be as well to consider for the moment that the orders named in the diagram, (page 62,) were allowed to be upon the same level, or in other words, of the same degree of dignity, but such a position can scarcely be maintained, even supposing Ferns to occupy an intermediate position between Acrogens and Exogens we can scarcely place Fungi on a level with Mosses, yet the situation of the orders as they are expressed in the diagram is in truth such as is absolutely required to allow of their connexion with the higher classes. If we suppose the axis of development of this class to pass from between Algæ and Fungi, group 1, to between Polypodiaceæ and Lycopodiaceæ, group 3, (page 62.) we find exactly the same instance of a connexion from the lowest to the highest orders of the cellular and vascular classes as we do in the vascular class in Exogens and Endogens. Instead then of regarding the section represented in the above-named diagram as a level surface it must be looked upon as an inclined plane, gradually rising in the direction of the axis mentioned above, and may be thus represented.

Exogenæ. { Filices. Ophiogloss. Lycopod. Marsileaceæ. Jungerm. Bryaceæ. Marchantiaceæ.

Endogenæ. { Lichenes. Fungi. Algæ.

This arrangement also has the advantage of not involving the necessity of supposing that the higher forms as Ferns and Lycopodiaceæ are connected by some species to Algæ, and must infallibly be presumed by the diagram at page 62. It would from this appear almost certainly that any figure intended to represent the acrogenous class at any rate should have more length than breadth, and more surely that the connexions of the three classes are not to be truly represented by three spheres which could only touch at points, whereas the connexion is in nature maintained throughout. Characeæ and Equisetaceæ are omitted from the above diagram, for it is as yet wholly uncertain where the former order should stand, and Equisetaceæ are as equivocal in position, and are indeed by some removed entirely from this class.

CLASS II.—ENDOGENÆ. (Monocotyledons.)

Group 1.—SPADICOSÆ. (Flowers on a spadix incomplete, embryo usually with a lateral slit.)

All. 1.—*Rhizanthales*. parasitical, leafless, seeds sporuliferous.

Balanophoraceæ. *Fungi. Typh. Arac.* Cynomoriaceæ. Cytinaceæ. Rafflesiaceæ. *Aristoloch?*

All. 2.—*Fluviales.* exalbuminous, or stem and leaves confounded.

Pistiaceæ. *Hepat.* Juncaginaceæ. *Junc. Arac.* Naiadaceæ. *Podost. Arac.*

All. 3.—*Arales,* albuminous.

Typhaceæ. *Saur. Balanoph. Glum.* Acoraceæ. Araceæ. *Pip. Rhiz.* Taccaceæ. *Aristol.* Pandanaceæ. *Bromel?* Cyclanthaceæ. *Palmaceæ.*

Group 2.—HYPOGYNOSÆ (ovarium superior.)

All. 1.—*Cyperales.* Floral envelopes glumaceous, culms solid.

Cyperaceæ. *Gram. Typh. Junc.* Restiaceæ. *Junc. Xyrid.* Desvauxiaceæ.

All. 2.—*Graminales.* glumaceous, culms fistular.

1. Heteroclinæ.	2. Homoclinæ unifloræ.	3. Homoclinæ multifloræ.
1. Phalarideæ.	7. Phleoideæ.	11. Pappophoreæ.
2. Paniceæ.	8. Agrostideæ.	12. Chlorideæ.
3. Tristeginæ.	9. Stipeæ.	13. Aveneæ.
4. Sacchareæ.		14. Arundineæ.
5. Rottboellieæ.		15. Triticeæ.
6. Olyreæ.	10. Oryzeæ.	16. Festuceæ.
	17. Bambuseæ.	

Streptochæteæ. Arundinarieæ. Bambuseæ veræ.

All. 3.—*Palmales.* arborescent.

Palmaceæ. *Gram. Lil.*

All. 4.—*Commelales.* albuminous tripetaloid.

Philydraceæ. *Junc. Rest. Orchid?* Xyridaceæ. *Rest.* Commelinaceæ. *Rest.*

All. 5.—*Liliales.* albuminous, hexapetaloid.

Juncaceæ. *Rest. Cyp. Juncg.* Smilaceæ. *Menisp.* Melanthaceæ. Gilliesiaceæ. *Rest.* Liliaceæ. *Palm. Amaryl.* Pontederaceæ. *Butom.*

All. 6.—*Alismales.* exalbuminous tripetaloid.

Alismaceæ. *Ranunc. Hydroch.* Butomaceæ. *Ponted. Hydroch.* [Limnocharaceæ]. *Nymph.*

Group 3.—EPIGYNOSÆ. (Ovarium inferior, floral envelopes complete.)

All. 1.—*Hydrales.* albumen absent or mealy tripetaloid.

Hydrocharaceæ. *Nymph. But. Alis.* [Stratiotiaceæ]. Bromeliaceæ. *Hæmod. Burm. Pand?*

All. 2.—*Narcissales.* hexapetaloid.

Burmanniaceæ. *Xyr. Philyd.* Hæmodoraceæ. Amaryllidaceæ. *Lil?* Dioscoreaceæ. *Smil.* Orchidaceæ. Iridaceæ.

All. 3.—*Amomales.* albuminous, tripetaloid, feather-veined.

Musaceæ. Zingiberaceæ. Marantaceæ. *Irid. Orchid.*

No great objection can, I think, be taken to the mode of arranging the endogenous portion of the vegetable kingdom which is here proposed, which is in conformity with the principles which will be adopted in dividing the class of Exogens, and does not differ very materially from any hitherto in use. The Spadiceous group is never in risk of being confounded with any of the rest, and has always been respected; the Glumaceous I have combined with the Hypogynous on account of the very many points of affinity existing between those two. Gynandrosæ can hardly be kept separate from Epigynosæ,

as Dr. Lindley himself suspects. As for Retosæ the number of individuals composing that are so few, and so evidently intermediate between Monocotyledons and Dicotyledons that they appear best combined with their affinities Amaryllidaceæ and Liliaceæ. It is worth remarking that in whatever manner Endogens are primarily divided, the division appears best effected in a ternary manner; in the above I have extended the application of this, considering that this class will afford a fair experiment upon the influence of numbers, if any such thing there is. At all events if Exogens are arranged as they usually are, apparently falling naturally into a quinary method, Endogens ought equally to yield to a ternary arrangement.

It is to be expected that these plants will afford a fair test of the truth or fallacy of this idea, for we are probably better acquainted with the types of structure in this than in the other class of Vasculares; their relations also appear to be less complex, which might argue the prevalence of a more simple number, and if there be any foundation for such a numerical arrangement, it will be likely to be more easily established here than elsewhere, because Endogens are so remarkably constant to their ternary number of parts that it might almost be established as a rule that any deviation therefrom might be considered as a deterioration from the character of a plant evincing it, as a Monocotyledon.

I wish to offer a few words concerning the presumed inapplicability of the apetalous, polypetalous and monopetalous characters to the species of this class, which though not usually made use of appear to be as certainly

existing here as in the tribes of Exogens. Thus the spadiceous and glumaceous portions may be considered strictly analogous to Incompletæ. The tripetaloid orders to Polypetalæ, and the hexapetaloid to Monopetalæ. That all degrees of adhesion are to be found between the floral envelopes in some orders as Liliaceæ when the character is not even considered of ordinal value is no objection, when it is remembered that orders are artificial divisions, and that therefore in a truly natural arrangement of species the respective quantity of adhesion may be found to have due signification and to be continued uninterruptedly through species of several different orders whose apparently disjointed and distant stations when properly regarded are to be looked upon like the various tribes of Terebintaceæ, found in many different groups but really standing side by side.

Although not entirely corresponding with the same divisions as Exogens, Endogens appear to attain dignity much in the same way by the production of floral leaves and the adhesion subsequently formed among them, though the grand feature of their advance in rank appears to be by the concentration of the calycine and corolline whorls into a hexapetaloid flower. In the Incomplete division the glumaceous and spadiceous tribes present only two instances of the floral leaves being composed of six pieces, Restiaceæ which are subject to exception, and Juncaginaceæ where in Triglochin maritimum, at all events the so-called petals or interior whorl is above that of the exterior row of stamens which overlie them in estivation. In the hypogynous tripetaloid orders there is no instance of the petals being ever adherent which is a

great point of similarity to Polypetalæ, which their position assimilates them to, being between the incomplete and monopetalous series, as is evident from their herbaceous calyx; and an additional argument, if any such be required, for considering by analogy polypetalous Exogens inferior to Monopetalæ. The various degrees of adhesion in the perianth of hexapetaloid Endogens would probably on examination be found to indicate those plants most exalted in rank in which this quality is most freely developed.

By reference to the frontispiece it will be seen that I have considered these groups of Endogens as well as the rest, to be capable of representation by something of a spiral figure, coiled as it were round a central modiolus, which in both the vascular classes appear to be epigynous. The spadiceous, or lowest spiral, has no apparent connexion with the epigynous, so that it may be conceived to be external as it were with respect to the rest. It arises by Rhizanths, and maintaining connexion with Acrogens by Fluviales seems on one side to touch on Exogens by Fluviales and Podostemaceæ, and by Araceæ, Piperales and Aristolochiaceæ; on its endogenal side Typhales approximate it to Glumosæ, and by Cyclanthaceæ, its highest point, it apparently approaches Palms. Hypogynosæ, commencing by Cyperales and connected with Spadicosæ, as before described, joins Epigynosæ by Commelales, Philydraceæ and Xyridaceæ, apparently approaching Iridaceæ and Orchidaceæ, and by Liliales, Narcissales, by Alismales, Hydrales. The hypogynous group approximates to Exogens by the smilaceous portion of Liliales touching on Menispermales

and Alismales upon Ranales, the same thing is accomplished by Dioscoreaceæ in Narcissales and Hydrocharaceæ in Hydrales.

As we consider the cases of approximation here pointed out as those of affinity or of analogy, so we must conceive the idea of this or any other portion of the vegetable system being homogenous, or the contrary; in other words, whether groups can be defined or not. In many of these instances it certainly does appear that although the closest general resemblance is effected, still some bar exists which is not removed, and therefore these are cases of approach and not of actual transition, that is to say, there is more difference between Smilaceæ and Menispermaceæ, or Cyclanthaceæ and Palmaceæ, than there is between any two species in the genera of these orders. The most extensive acquaintance with the vegetable kingdom is however required to verify either of these hypotheses.

In apology for the ternary arrangement of Monocotyledons here offered, I should mention as some excuse, that reference to the genera of the orders will show that in general their sections are conformable to such a plan; those of Graminaceæ, by Professor Nees von Esenbeck, are adduced here as an example, and in reference to the analogical approach of groups, it is worth while to quote his observation on that arrangement of the order "Tribus graminearum commodè in tres series dividuntur, quarum singulæ partes recta via a se invicem discedentes, analogia quadam collaterali sibi vicissim respondent."

CLASS III.—EXOGENÆ. (Dicotyledons.)

Group 1.—APOCARPOSÆ. (Carpels or Styles separate.)

All. 1.—*Podostemales.* Achlamydeous, Carpels more than one, combined.

Podostemaceæ. *Hepat. Fluviales.* Callitrichaceæ.

All. 2.—*Piperales.* Achlamydeous, hermaphrodite, carpels single or quite distinct.

Chloranthaceæ. *Lacist. Gnet.* Saururaceæ. *Naiad. Typh.* Piperaceæ *Polyg. Urt. Arac. Lacist.*

All. 3.—*Lacistemales.* Apetalous, placentæ parietal, flowers amentaceous.

Lacistemaceæ. *Chlor. Pip.*

All. 4.—*Monimiales.* Achlamydeous unisexual, flowers involucrate.

Monimiaceæ. *Urt. Laur. Calyc?* Atherospermaceæ. *Laur.*

All. 5.—*Laurales.* Flowers incomplete, anther valves recurved.

Lauraceæ. *Ath. Mon. Myrist.* Illigeraceæ. Cassythaceæ.

All. 6.—*Menispermales.* Wood without zones, calyx biseriate.

Menispermaceæ. *Smil. Malv? Euph?* Lardizabaleæ.

All. 7.—*Nepenthales.* Leaves or flowers ascidious.

Sarraceniaceæ. *Pap.* Cephalotaceæ. *Franc.* Nepenthaceæ. Aristolochiaceæ. *Arac. Elæag?*

All. 8—*Berberales.* Polypetalous, anther valves recurved.

Berberaceæ. *Ap. Podoph. Anon. Vit. Menisp?*

All. 9.—*Ranales.* Polypetalous. embryo at the base of abundant albumen. herbaceous.

Ranunculaceæ. *Dill. Mag. Umbel. Alism. Ros.* Podophylleæ. Francoaceæ.(?) Nelumbiaceæ. *Alism.* Nymphæaceæ. *Mag. Hydroch. Butom.* Hydropeltideæ.

All. 10.—*Anonales.* Polypetalous, embryo at the base of abundant albumen, arborescent.

Winteraceæ. *Calyc.* Magnoliaceæ. *Ran.* Anonaceæ. *Berb. Menisperm?* Schizandreæ. Myristicaceæ. *Laur.* Dilleniaceæ. *Pitt. Ran.*

All. 11.—*Rosales.* Polypetalous, exalbuminous, odd lobe of calyx next axis.

Rosaceæ. *Fab. Sax. Samyd? Ran.* Pomeæ. Amygdalaceæ. Sanguisorbeæ. Neuradeæ. Chrysobalanaceæ. *Fab.* Calycanthaceæ. *Mon. Wint.* (Crassulaceæ. *Franc.*)

All. 12.—*Fabales* Polypetalous, exalbuminous, odd lobe of calyx remote from axis.

Fabaceæ. *Ros. Polyg. Trigonieæ.* Mimoseæ. Cæsalpinaceæ. Connaraceæ. *Coriar?* Amyridaceæ. *Anac. Burs. Aurant.*

Notwithstanding the group before us is composed of orders now perhaps for the first time assembled, a common bond of affinity seems to extend through them all, and they are tolerably constant to the character assigned to them, viz. of being apocarpous; when this character fails the albuminous one appears to afford sufficient reasons for such orders being included within their ranks. The inferior tribes are much disconnected, but constituting as they do a portion of Dr. Lindley's Albuminosæ, nothing need be said on my part upon their account. My reasons for not including the remainder of that collection are, that as we are unable at present to arrange the whole system by the qualities of the embryo, that if the vegetative organs are employed as characters

in one part they ought to be generally applied. Of course, although the epigynous Albuminosæ are removed, they are not supposed to stand at a greater distance from the hypogynous than heretofore, their connexion is still preserved most carefully, as a character which promises so much, should be. Regarding the signification of the excessive quantity of albumen, the general opinion is, that its office is to afford nourishment to the embryo during its germination in the earth; thus the plant possessing this physiological peculiarity may possibly be considered analogous to the Marsupial family of Mammalia, the embryo being produced in an imperfect state. The group in question being the only one among Exogens which appears to have any connexion with Endogens, might lead us to deduce the proximity of the two as the cause of this deficient development: certain it is, that almost all Monocotyledons have abundant albumen, and when they are as is called exalbuminous, some especial provision seems to be made for the nourishment of the germ by the thickened radicle of Alismaceæ, &c. and the fleshy embryo of Orchideæ. If such disproportions between parts usually differently circumstanced are of any value, it admits of a question whether such thick Cotyledons as Lauraceæ and Nelumbiaceæ may not have the same functions, and possibly the same may in some degree be the office of the same parts excessively lengthened, as the convolute Cotyledons of Calycanthaceæ, &c. A further tendency to imperfection appears to exist in these orders by the great number of parasitical plants to be found there, if we extend the term, as I think we very well may, to ascidious plants as Nepen-

thes, Sarracenia, and Dionæa, which appear to compensate for the deficient nourishment derived from their roots, by entrapping insects into their leaves, the putrefaction of which may act upon their system as a kind of manure. Twiners may probably be included under the same denomination; which do not thrive without the support of some other plant, and in some species, as Hedera, seem to have a fair title to parasitical, by emitting roots during the whole course of the stem, perhaps the notion is strengthened by twiners often being closely affixed to real parasites, as Illigeraceæ to Cassythaceæ, Convolvulaceæ to Cuscutaceæ, &c. Some further evidence for supposing the forms of parasitical and twining plants in some way connected is to be derived from the formation of the wood and stem. The plants most remarkable for eccentricity of pith are twiners, but our Viscum resembles them in that respect, the form of the stem in this plant is oval instead of round, and the eccentricity of the pith is occasioned by the zones of wood and bark being thickest on the side which is uppermost while the plant is growing, which is in a direction more or less horizontal. Can this be occasioned by some peculiar power in these plants to deposit more wood, &c. on that side which is next the light? and, if so, does not this property in some measure explain the cause of the stem assuming a twining habit? for the production of tissues being greater on the side next the light will necessarily occasion a flexion of the stem in the opposite direction.

Group 2.—DICLINOSÆ. (Sexes separate.)

All. 1.—*Pinales.* Gymnospermous.

Cycadaceæ. *Filic.* Taxaceæ. Pinaceæ. *Lycop.* Gnetaceæ. *Casuar. Equi. Chloranth.*

All. 2.—*Casuarales.* Stems jointed, sheathed, leafless.

Casuaraceæ. *Myric. Pin. Equis. Gnet.*

All. 3.—*Salicales.* Amentaceous achlamydeous.

Salicaceæ. *Betul.* Liquidambaraceæ. *Bet.* Platanaceæ. *Bet. Myric. Urt.*

All. 4.—*Urticales.* Apetalous, carpel single or not cupuliferous.

Garryaceæ. *Coryl. Pip. Gnet. Chlor.* Hensloviaceæ. *Comb.*? Trewiaceæ. Urticaceæ. *Chenop. Polyg. Mon. Platan. Euph?* Myricaceæ. *Bet. Cas.* Stilaginaceæ. *Coryl.* Ulmaceæ. Datiscaceæ.

All. 5.—*Amentales.* Apetalous, amentaceous, syncarpous.

Corylaceæ. *Sal. Garr* Betulaceæ. *Urt. Plat. Sal.* Scepaceæ. *Urt.* Juglandaceæ. *Burserales.*

All. 7.—*Burserales.* Polypetalous, juice balsamic.

Burseraceæ. *Amyr. Mel. Rham.* Anacardiaceæ. *Amyr.* Xanthoxylaceæ. *Conn. Aur. Euph. Olea.*

All. 8.—*Euphorbiales.* Tricarpous, seeds twin or solitary.

Euphorbiaceæ. *Malv. Rham. Celast. Xanthox. Urt?* Empetraceæ. *Celast. Urt?*

All. 9.—*Acerales.* Polypetalous, calycose oligandrous.

Aceraceæ. Sapindaceæ. *Mel. Vit?* Millingtonieæ. (Æsculaceæ.) *Rhizob.*

All. 10.—*Guttales.* Polypetalous, calycose, polyandrous.

Clusiaceæ. *Eben. Dipt.* Canelleæ. *Mel.* (Marcgraaviaceæ. *Eben. Eric. Hippocrat.* Rhizobalaceæ. *Aesc.* Hypericaceæ. *Cist. Ternst. Sauvag. Sax?* Ochranthaceæ.) Ternstromiaceæ. *Til? Lecyth?*

All. 11.—*Ebenales.* Monopetalous, Cotyledons foliaceous.

Ebenaceæ. *Clus. Aquif.* Oleaceæ. *Xanth.* (Jasminaceæ. *Verb.*)

This group is in a great part of it more open to objection, and less satisfactory, than any we shall have occasion to establish; its limits are very ill defined, though its existence may be fairly presumed from the very constant character of unisexuality in the Apetalous portion, and the no less remarkable facts of orders with such high stations as Euphorbiaceæ, Clusiaceæ, and Ebenaceæ, showing a decided tendency to the separation of the sexes. Dr. Lindley's diclinous group is rendered very distinct by his rejection of even polygamous orders; on the contrary I have considered that character a sufficient excuse for stationing some tribes in this position, and probably such as Celastrales, in which some genera have an unisexual structure. But some accessory character seems required to support this diclinous one, if indeed the group is allowed to exist in Monopetalæ or Polypetalæ, which there seems much reason for presuming. It is not unworthy of notice that unisexuality, which is an universal attribute of the higher animals, is detrimental to rank in vegetables, we must suppose, therefore, that in the above group some other circumstances may be found which may counterbalance this defect.

Group 3.—SYNCARPOSÆ. (Carpels united.)

All. 1.—*Daphnales.* Incomplete, tubiferous, estivation imbricate, or carpels more than one.

Elæagnaceæ. *Sant. Prot. Comb.* Thymelaceæ. *Sant. Prot.* Hernandiaceæ. Aquilariaceæ. *Chaill.* Peneaceæ. *Prot. Brun?*

All. 2.—*Proteales.* Incomplete, tubiferous, estivation valvate, stamens opposite lobes of calyx.

Protæaceæ. *Loranth?* Santalaceæ. *Elæg. Daph. Comb.*

All. 3.—*Geraniales.* Polypetalous, estivation imbricate, gynobasic, styles separate at the point.

Geraniaceæ. *Mal. Lin. Sil. Viol.* Balsaminaceæ. Tropæoleæ. Oxalidaceæ. *Zygophyll.* (Limnanthaceæ) *Rut. Trop. Ros?*

All. 4.—*Malvales.* Polypetalous, estivation valvate or calycose, carpels 4 or more.

Malvaceæ. *Ger. Lin. Ran? Ternot? Euph.* Chlenaceæ. Tiliaceæ. Elæocarpaceæ. Sterculiaceæ. *Rham.* Lythraceæ. *Onag. Melast. Celast. Tamar.* Dipteraceæ. *Clus.*

All. 5.—*Rhamnales.* Polypetalous, estivation valvate, carpels fewer than four.

Rhamnaceæ. *Sterc. Cel. Aquif. Euph. Myrt.* Chailletiaceæ. *Anac. Ros? Homal. Aquif.* Tremandraceæ. *Polygal.* Nitrariaceæ. *Chen. Tetrag. Reaum.*

All. 6.—*Celastrales.* Polypetalous, with a large often cup-shaped disk.

(Brexiaceæ.) *Myrs. Pitt?* Celastraceæ. *Rut. Rham. Lyth.* Hippocrateæ. *Marc.* Trigonieæ. *Moring.*

Legum? Polyg? Malpighiaceæ. *Acer.* Staphyleaceæ. *Sapind.* Stackhousiaceæ. Fouquieraceæ. *Port. Crass?* *Turn?* *Loas?*

All. 7.—*Pittosporales.* Polypetalous, embryo minute at the base of albumen.

Pittosporaceæ. *Brex? Berb. Dill. Mel?* Olacaceæ. *Aurant?* Vitaceæ. *Aral. Ger.*

All. 8.—*Meliales.* Polypetalous, carpels 4 or more, calyx inbricate.

Meliaceæ. *Rut. Sapind. Burs. Pitt? Vit?* Cedrelaceæ. *Rut.* Humiriaceæ. *Chlen? Styr?* Aurantiaceæ. *Amyr. Conn. Rut. Xanth.* Spondiaceæ. *Anac. Burs.*

All. 9.—*Rutales.* Polypetalous, gynobasic style single, or leaves dotted, carpels five.

Rutaceæ. Diosmeæ. *Eric. Aur. Ced. Mel. Euph.* Zygophyllaceæ. *Oxal.* Simarubaceæ. Ochnaceæ. (Coriariaceæ *Conn?* Surianaceæ. *Ger.*)

All. 10.—*Ericales.* Monopetalous, anthers opening by pores, hard and dry, with appendages.

Vacciniaceæ. *Camp.* Ericaceæ. *Camp. Rut. Caprif?* Epacridaceæ. Pyrolaceæ. Monotropaceæ. *Orob.*

All. 11.—*Primulales.* Monopetalous, anthers without appendages.

Primulaceæ. *Sol. Eric. Scrop. Plant.* Myrsinaceæ. *Brex. Rham.* Sapotaceæ. Styraceæ. *Humir. Mel.* Aquifoliaceæ. *Celast.*

All. 12.—*Plantales.* Monopetalous, inflorescence aggregate, usually monospermous, carpels single.

Plantaginaceæ. *Prim.* Globulariaceæ. *Dips.* Salvadoraceæ. Plumbaginaceæ.

The syncarpous character is scarcely applicable either to the orders at the commencement or end of this group, unless the slight lobing of the stigma on one hand, and the circumstance of Penæaceæ on the other having concrete carpels among the rest of its allies in which the fruit is solitary, can be allowed as sufficient indications of such a structure, otherwise the group, although with a character very general in its application, does not present many anomalies as its dichinous and apocarpous genera can very well be supposed to stand on the limits of this and the collections of plants to which those characters belong; the same observation is applicable to the epigynous orders to be found here, and which seem as they stand to be ranged with their nearest allies.

Group 4.—DICARPOSÆ. (carpels 2-3, or with parietal placentation, embryo often curved.)

All. 1.—*Chenopodiales.* Incomplete, embryo curved, albumen mealy.

Chenopodiaceæ. *Mesembr. Tetrag.* Amarantaceæ. Tetragoniaceæ. Phytolaccaceæ. Polygonaceæ. *Urt.* Petiveriaceæ. Scleranthaceæ. Nyctaginaceæ.

All. 2.—*Silenales.* Polypetalous, embryo curved, albumen mealy, oligandrous.

Silenaceæ. *Lin. Ger. Oxal. Viol.* Alsinaceæ. Portulaceæ. *Fouq. Cact. Tetrag. Prim??* Illecebraceæ. *Amarant. Crass.*

All. 3.—*Papaverales.* Polypetalous, albuminous, placentæ parietal, petals 4, cruciate.

Papaveraceæ. *Sarr. Cist. Brass?* Fumarieæ.

All. 4.—*Cruciales.* Polypetalous, embryo curved, placentæ parietal. carpels 2-3-4. exalbuminous.

Capparidaceæ. *Pap. Flac* Resedaceæ. Brassicaceæ. *Pap?*

All. 5.—*Cistales.* Polypetalous, Calycose polyandrous, carpels 2-5, embryo curved, or albumen mealy.

Bixaceæ. *Homal. Flac. Pass. Ros?* Cistaceæ. *Viol. Pass. Hyp. Pap.* Reaumuriaceæ. *Hyp. Tam.*

All. 6.—*Passionales.* Polypetalous, Placentation, parietal, carpels 3-5, with a corona.

(Papayaceæ.) *Cuc.* Passifloraceæ. *Cuc. Viol. Sam. Capp. Belv.* Malesherbiaceæ. Turneraceæ. *Loas. Cist. Malv.* Flacourtiaceæ. *Capp. Sam.*

All. 7.—*Violales.* Polypetalous, Placentation, parietal, carpels 3-5, without a corona, oligandrous.

Violaceæ. *Polyg. Voch? Pass. Sil. Ger.* Sauvagesieæ. *Hyp.* Moringaceæ. *Fab.* Samydaceæ. *Bix. Ros. Pass.* Droseraceæ. *Sax. Sarr.* Frankeniaceæ. *Sil. Lin.* Tamaricaceæ. *Lyth. Onag. Reau. Sil.*

All. 8.—*Linales.* Polypetalous, calycose, Placentæ central, carpels 3-5.

Chlenaceæ. *Malv. Pist. Eben?* Hugoniaceæ. *Malv. Oxal. Cist.* Linaceæ. *Sil. Mal. Ger.* Elatinaceæ. *Als. Hyp.*

All. 9.—*Polygalales,* gamopetalous flowers unsymmetrical calycose, carpels 2.

Polygalaceæ. *Viol. Trem. Fab. Rut. Acanth.* Krameriaceæ.

All. 10.—*Echiales.* Monopetalous, flowers symmetrical, fruit nucamentaceous, inflorescence gyrate, carpels 2.

Boraginaceæ. *Lam.* Ehretiaceæ. Heliotropiceæ. Cordiaceæ. *Convol.* Hydrophyllaceæ. *Pol.*

All. 11.—*Lamiales.* Monopetalous, carpels 2, flowers unsymmetrical, nucamentaceous ovary 2-4 celled.

Lamiaceæ. *Bor. Rut.* Verbenaceæ. *Acanth. Scroph.* Myoporaceæ. Selaginaceæ. Stilbaceæ. *Glob.*

All. 12.—*Scrophulales.* Monopetalous, carpels 2, ⌒ flowers unsymmetrical, fr. capsular.

Lentibaceæ. *Scroph. Prim.* Scrophulariaceæ. *Sol. Verb. Prim. Gent?* (Orobanchaceæ) *Monot.* Gesneraceæ. Bignoniaceæ. Cyrtandraceæ. Pedaliaceæ. Acanthaceæ. *Polygal.*

All. 13.—*Polemoniales.* monopetalous, fruit 2-3 celled, embryo strait.

Polemoniaceæ. *Gent. Conv.* Diapensiaceæ. Hydroleaceæ. *Bor. Hydroph.*

All. 14.—*Solanales.* Monopetalous, leaves alternate, embryo curved, carpels ⌒ corolla plaited, ovary 2-4 celled.

Solanaceæ. *Scroph. Prim.* Cestraceæ. *Pol.* Convolvulaceæ. *Cord.* Cuscutaceæ. (Nolanaceæ.)

All. 15.—*Gentianales.* Monopetalous, leaves opposite, embryo straight, carpels 2-4. ( )

Asclepiadaceæ. Apocynaceæ. *Cinch.* Potaliaceæ. Loganiaceæ. *Cinch.* Gentianaceæ. *Pol. Scroph? Convol. Cinch. Orobanch.* Spigeliaceæ. *Cinch.*

Gentianales is almost the only group whose position among the dicarpous orders appears questionable, although they have a strong relationship here: they are associated with the rest of albuminous orders in some arrangements, and they appear to have a tendency to an apocarpous structure, they moreover constitute an approach to Asterales which is not required here, being

effected in a different direction, namely, by Lamiaceæ and Mutisiaceæ, while the apocarpous group although containing some monopetalous genera cannot be shewn to be continued upwards into that zone.

Group 5.—EPIGYNOSÆ. (ovary inferior.)

All. 1.—*Combretales.* Polypetalous, placentæ central, estivation not valvate, fruit 1 celled.

Alangiaceæ. *Myrt. Corn. Hama.* Combretaceæ. *Onag. Myrt. Sant. Elæag.* Rhizophoraceæ. *Comb. Voch? Lyth. Cunon.*

All. 2.— *Cornales.* Polypetalous, albuminous, estivation valvate.

Loranthaceæ. *Caprif. Prot?* Cornaceæ. *Caprif.* Hamamelaceæ. *Sax. Brun. Aral. Alang.*

All. 3.—*Onagrales.* Polypetalous, exalbuminous, estivation valvate.

Onagraceæ. *Myrt. Lyth. Philad. Gros. Columell.* Circeæ. Hydrocaryes. Haloragеæ.

All. 4.—*Cucurbitales.* Polypetalous, placentæ parietal, or curvembryous, or unisexual.

Loasaceæ. *Onag. Turn.* Cucurbitaceæ. *Pass. Campan. Onag.* Cactaceæ. *Port. Illeceb.* Homaliaceæ. *Malesherb. Pass. Ros. Flac. Bix.* Mesembryaceæ. *Tetrag. Chenop. Crass. Silen.* Begoniaceæ.

All. 5.—*Myrtales.* Polypetalous, estivation not valvate, placentæ central, carpels usually more than one celled.

Myrtaceæ. *Ros. Lyth. Onag. Comb. Anon?* Barringtonieæ. Memecylaceæ. *Comb.* Melastomaceæ. *Lyth. Gent.* Philadelphaceæ. *Hydrang. Columell.* Lecythidaceæ. *Ternst.*

All. 6.—*Saxales.* Polypetalous, carpels 2 diverging.
Baneraceæ. *Ros.* Cunoniaceæ. *Philad. Rhizoph.*
Saxifragaceæ. *Ros. Gross.* Hydrangeæ. *Caprif.*

All. 7.—*Grossales.* Polypetalous, inflorescence racemose, albumen larger than the embryo.
Grossulaceæ. *Sax. Onag. Berb. Pitt.* Bruniaceæ. *Corn. Apiaceæ. Myrt?* Escalloniaceæ. *Sax?*

All. 8.—*Umbellales.* Polypetalous, albumen larger than embryo, inflorescence umbellate.
Apiaceæ. *Brun. Berb. Ran. Gal. Sax. Cap. Ger?*
Araliaceæ. *Caprif. Vitaceæ.*

All. 9.—*Cinchonales.* Monopetalous, leaves opposite.
Caprifoliaceæ. *Apoc. Lor. Sax. Ap. Aral. Campan Eric?* Cinchonaceæ. *Asterales. Apoc. Logan. Gent.* Galiaceæ. *Ap.*

All. 10.—*Campanales.* Monopetalous, 2 or more perfect carpels, seeds indefinite, leaves usually opposite.
Campanulaceæ. *Cinch. Caprif. Eric. Val.* Lobeliaceæ.
Sphenocleaceæ. Stylidiaceæ. Goodeniaceæ.
Scævolaceæ. (Brunoniaceæ.) (Belvisiaceæ.) *Cuc. Pass.* (Columelliaceæ.) *Jasm? Halisieæ. Onagraceæ. Philad.*

All. 11.—*Dipsales.* Monopetalous, stamens not syngenesious, only one perfect carpel.
Dipsaceæ. *Glob. Asterales.* Valerianaceæ. *Camp. Asterales.*

All. 12.—*Asterales.* Monopetalous, flowers aggregate, stamens syngenesious.
Cynaraceæ. *Cinch.* Asteraceæ, Cichoraceæ. *Camp. Lob.* Mutisiaceæ. *Lam.* Calyceraceæ. *Dips.*

As the foregoing groups are not proposed as being of a practical but entirely of a theoretical nature, I am not so much called upon to defend the exceptions which occur to their characters, which are probably inseparable from collections of such extent, and my object has only been to trace out some very general quality through a train of orders, undoubtedly connected by affinity. I shall therefore only observe that a great number of these anomalies are transition cases, and that many of the rest occur in orders of uncertain position. It therefore only remains to describe the connexions of these groups one with another, by which some alliances which could not be expressed before will be indicated.

The apocarpous group taking its rise by Podostemales becomes connected by Piperales with Arales among Endogens, and with Gnetaceæ and Urticales, in the diclinous group of Exogens; it is further connected with Arales by Aristolochiaceæ, and with Smilaceæ by Menispermaceæ. Ranales next constitute a passage to Alismales and Hydrales, and by the curious group of orders with the pitcher-shaped leaves to Droseraceæ in the dicarpous group, to which a further affinity is shown by the affinity of Papaveraceæ and Cistaceæ; nor are Rosaceæ without some alliances as is seen by Samydaceæ and possibly Bixaceæ; the approximation of these groups is also confirmed by the similitude of Fabaceæ and Polygalaceæ, and Moringaceæ; on the other hand Anonales approach Pittosporales, and Laureales Daphnales in the syncarpous group, which is further accomplished by the passage of the Terebintaceous orders of the same to the Melial alliance and the diclinous group in general. To

return to the dicarpous group which taking its rise by Chenopodiales is by them connected with Urticales in the diclinous group, and by Polygalales with the Aceral, and by Cistales with the Guttal in the same, by Lamiales it touches the Oleal and Asteral, which last it does apparently by the Gentianal. To the syncarpous, the passage is by Silenales and Fouquieraceæ, Cistales and Malvales, Violales and Geraniales, Scrophulales and Primulales. This syncarpous group arising apparently by the Tubiferous apetalous orders, tends to the diclinous group by Elæagnaceæ in these, and by Celastraceæ and Rhamnaceæ to Euphorbiaceæ and Acerales; Meliales appear to have some affinity with the latter alliance and also with the Guttal, and Primulales are connected with Ebenales, by Ericales Campanales are approached, and also perhaps Gentianales. The other alliances and those of Diclinosæ have been sufficiently pointed out, those of the epigynous group alone remain. It is not very easy to determine from what point we should date the commencement of these, whether from some very low one shown by Halorgeæ and Hippurideæ, of Onagrales, or from such epigynous species as Corylaceæ, or others, as Santalaceæ. Ficoidaceæ however certainly bring them near Chenopodiales, with Passionales in the same dicarpous group Cucurbitales connect them, and also to Silenales by Cactaceæ and Portulacaceæ; with Passionales also by Homaliaceæ; Scrophulales touch them by Gesneraceæ, and Lamiales by Mutisiaceæ. Gentianales are in close contact with Cinchonales, and Melastomaceæ. Apocarposæ they meet by Ranales and Umbellales, and Rosales and Saxales and Myrtales,

which last seems to approach Eupomatia in Anonaceæ. Syncarposæ join them by Lythraceæ, and Malvaceæ, Vitaceæ, and Araliaceæ, Ericaceæ, and Campanulaceæ, No real diclinous order appears to exhibit any strong symptoms of alliance with the Epigynous group, though Ternstromiaceæ, which cannot be situated very distantly from the former group, seem to be allied to Lecythidaceæ.

It is a matter as much beset with difficulties and uncertainties to contrive a plan for expressing and representing, as it is to determine the existence of the different affinities. In the frontispiece to this Work I have, however, attempted such a scheme, in which fig. 1. shews the spherical form adopted as the most simple; fig. 3. the inclined or spiral direction of the groups round the central one; fig. 2, a transverse section of the exogenous system, in which the epigynous appears to be central, and the diclinous external, with respect to the rest. I could have wished to have avoided the inclined direction of the tracts, and to have formed a figure altogether more symmetrical, but I do not know that, after all, any particular objection can be taken to such an arrangement, and it is at least as accordant with a system of vegetables as any more regular or mathematical figure. It seems also warranted by the fact that it is incorrect to confine the affinities of orders to any very limited spot; they appear in many instances to be considerably extended; and to be manifested equally strongly on either side of a group, by giving them an inclined direction we can avoid too great an intersection of their rays of alliance. But it is not impossible that if such an arrangement as the albuminous character appears to be an earnest of, could be perfected, that the tracts might be

arranged in a more rectilinear method; such at any rate is the case with that particular group in the scheme here submitted to attention, supposing that the positions of orders are there correctly indicated, although better characters may in all probability be found for defining the groups. We ought not to strain the analogy between the two kingdoms too far, but, so far as it goes, it appears to give rise to the expectation that the classes of plants may be divided eventually much in the same way as those of animals have been; the development of the embryo, that is its mode of germination, if properly understood, would no doubt afford a true criterion of the degree of value to be reposed in the characters of the vegetative organs, and enable us to determine what there appears much reason to apprehend, namely, whether the function of one part of the seed may not be performed by another; whether a disproportionate size of cotyledons is not equivalent to an excess of albumen, or a foliaceous embryo to a leafy plumule? &c.

But if the foregoing enquiries and suggestions shall be proved to be of little practical or theoretical value, some little good can scarcely fail to be obtained, by directing enquiry to the "vast chain of Being," some portion of which this Work, although feebly, attempts to illustrate; even should they elicit no more than a confession, in the words of the annotator on the philosophical poem, from which the phrase above made use of is extracted, "that so harmonious a disposition in the nature of things, as is here implied, is transcendantly beautiful."

ERRATA.

Page 17, 3rd line—before Plutonic, *insert* "Metamorphic and"

— 27, 12th line—*erase the line*, and *read*, "been peculiarly adapted to the"

— 89, 3rd line from foot of page—*after* Lycopodales, *insert* "reproductive organs axillary, or"

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